Hunter Power Project

Environmental Impact Statement

Rev 0 - Final

22 April 2021

Hunter Power Project

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Document history and status

Revision	Date	Description	Author	Checked	Reviewed	Approved
0	22/04/2021	Final	T Colman M Terei	M Luger	M Luger	K Ivanusic

Executive summary

E.1. Proposal summary

Snowy Hydro Limited (Snowy Hydro) is an Australian Government owned corporation, employing nearly 2,000 people across Australia, whose core business is to generate electricity for supply into the National Energy Market (NEM) and for retail supply to homes and businesses. Snowy Hydro's role includes renewable and gas fired power generation, underpinning the transition to renewable energy through a combined portfolio of 16 power stations encompassing hydroelectric, gas and dual-fuel (gas/diesel), with a combined generating capacity of over 5,500 MW.

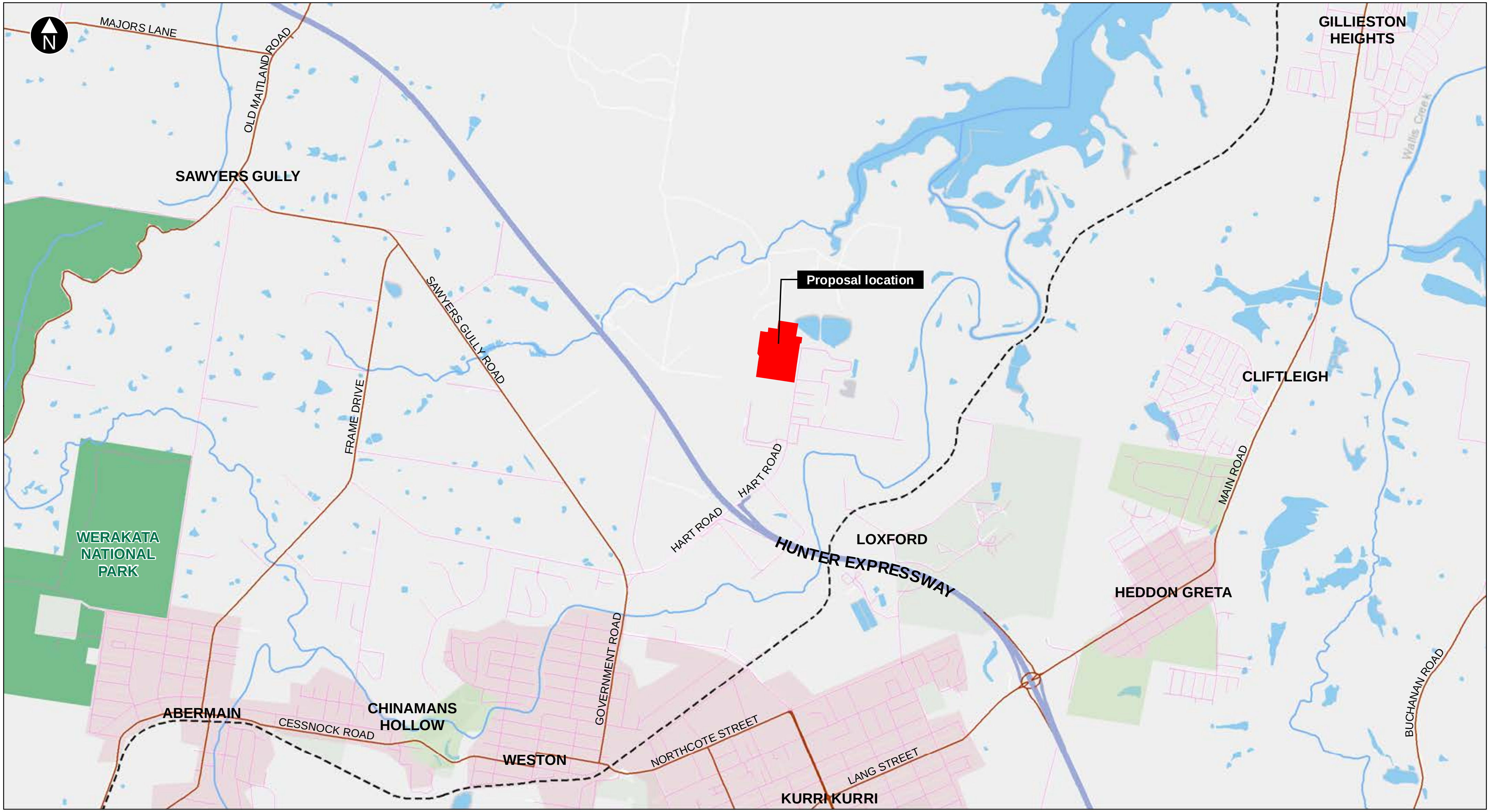
Snowy Hydro now seeks approval for the development of an open cycle gas fired power station near Kurri Kurri, NSW (the Proposal) (see Figure E.1). The Proposal involves the construction and operation of a power station, electrical switchyard and associated supporting infrastructure (see Figure E.2). The power station is expected to have a generation capacity of up to approximately 750 megawatts (MW), which would be generated via two industrial frame heavy duty F-Class gas turbine units in open cycle gas turbine configuration. The gas turbines would primarily be fired on natural gas with the use of diesel fuel as a backup.

The Proposal will operate as a "peak load" generation facility supplying electricity at short notice when there is a requirement in the NEM. The Proposal would connect into Ausgrid's existing 132 kV electricity overhead transmission infrastructure located adjacent to the Proposal Site.

The Proposal is being designed and approval is being sought to operate at a capacity factor of up to 10 per cent on natural gas and up to two per cent on diesel in any given year. However, it is expected that likely operations would result in a capacity factor of about two per cent in any given year. This means that in an average year, the proportion of actual energy generated by the Proposal, compared with its potential output if operated at full load for every hour of the year (expressed as megawatt hours), would be in the order of two per cent.

For gas operation, the Proposal would also require a new gas lateral pipeline and gas receiving station. These would be developed, constructed and operated separately to this Proposal by a third party, subject to a separate environmental assessment and planning approval. Gas would be supplied to the Proposal from Australia's existing gas fields that feed Sydney and Newcastle via the existing NSW gas transmission system.

The Proposal has a capital cost of approximately $610 million, and is anticipated to be operational by the end of 2023.



Proposal location

National Parks and Wildlife Services estate / reserve

Recreation areas

Urban areas

Waterbodies

Motorway

Main roads

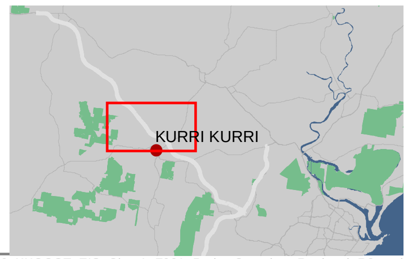
Roads

Railway

0 1 2 km

1:40,000 at A4

Coordinate System: GDA2020 MGA Zone 56



Data sources:
Jacobs
NSW Spatial Services

Figure E-1 Proposal location (regional)

Date: 5/03/2021 Path: J:\IE\Projects\04_Eastern\IS354500\22_Spatial\GIS\Directory\Templates\Figures\KurriKurriEIS\Chapters\Chapter1\IS354500_KKOCGT_EIS_Chap1_F001_ProjectOverview_Regional_R2.mxd
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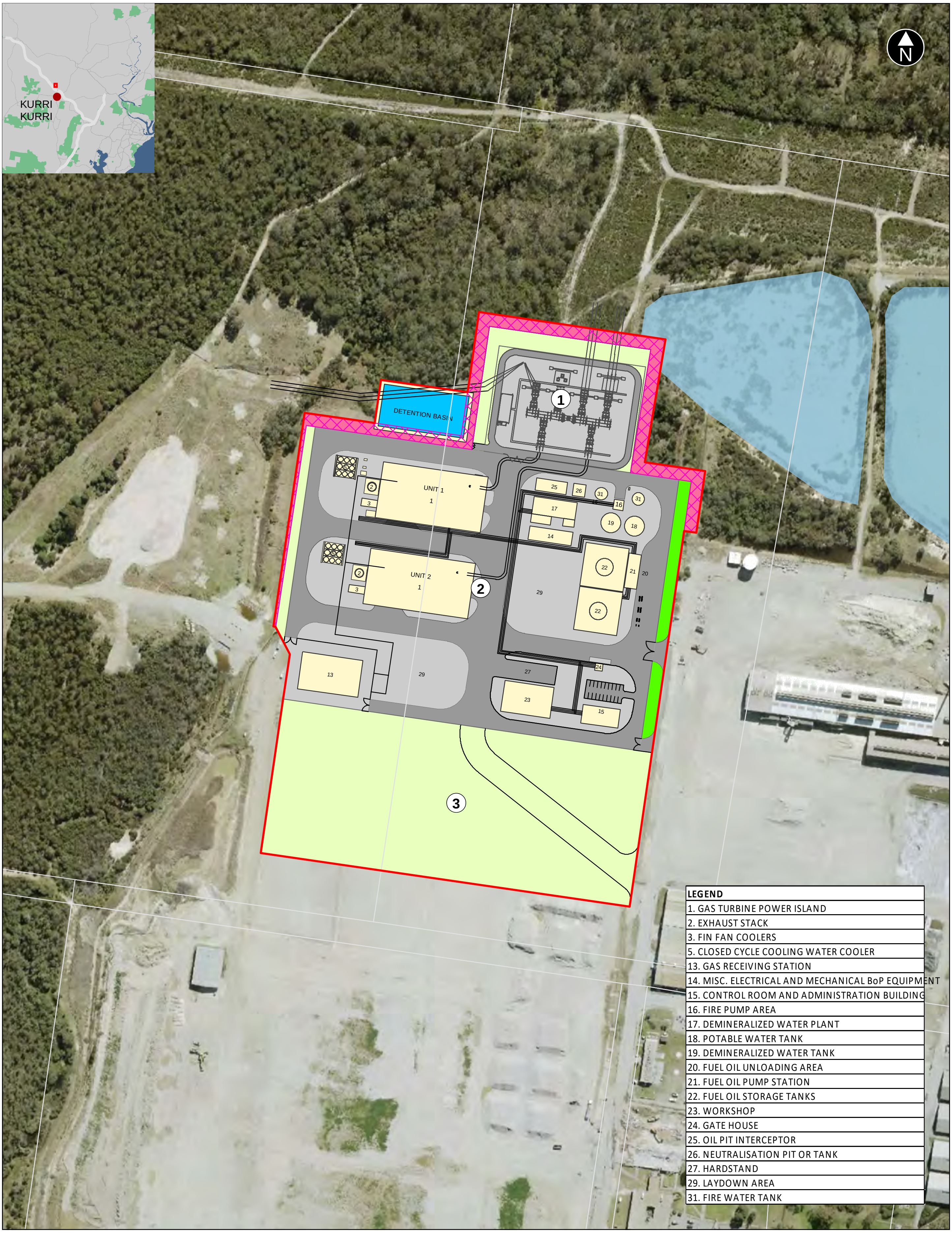

Proposal Site
Asset protection zone
Detention basin
Sealed roadway
Crushed rock
Landscaping
Grass / Road base
Existing waterbodies
Existing cadastre
1 Proposed Switchyard Area
2 Proposed Plant Area
3 Proposed Buffer Area

0 100 200 m

1:4,000 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure E-2 Proposal Site Layout

E.2. Proposal need

Dispatchable electricity and other network support services are increasingly being required and deemed critically important to the stability of the NEM, as more intermittent renewable energy generators enter the market, and as large thermal (coal fired) power stations such as Hazelwood (Victoria), Liddell (NSW) and Yallourn (Victoria), are either decommissioned or approach retirement.

In order to provide a reliable supply of energy during the transition to renewables, intermittent energy generation such as wind and solar need to be firmed. In the longer term, firming could come from a range of sources. The cost of batteries is falling, making storage an increasingly commercially viable option. However, storage alone will not be able to meet the shortfall in generation that will accompany the planned closure of the Liddell Power Station in 2023.

Open cycle gas turbines fuelled by natural gas represent an economic and feasible technology to perform this firming function. For times where natural gas is not available or is constrained, back-up fuel such as diesel can provide added security. The Proposal would operate as a 'peak load' generation facility capable of supplying electricity at short notice when there is a requirement in the NEM such as during periods of high electricity demand, low supply periods from intermittent renewable sources, supply outages at other baseload power stations, and transmission line constraints or outages.

The Australian Energy Market Operator (AEMO) has advised the Australian Government that with the closure of Liddell Power Station in 2023, there will be a gap in dispatchable capacity that will need to be filled through the addition of firming capacity. The Proposal's primary aim is to substantially contribute to meeting this need.

E.3. Location and existing environment

The Proposal Site is located at Hart Road, Loxford, about one kilometre (km) east of the M15 Hunter Expressway and about three km's north of the town of Kurri Kurri (see Figure E.1). The Proposal would be constructed on the site of the former Hydro Aluminium Kurri Kurri Pty Ltd (Hydro Aluminium) aluminium smelter. The smelter, which operated at the site from 1969 until 2012, was closed in 2014. Since its closure, the former aluminium smelter has undergone a staged demolition and site remediation process, which is scheduled to be completed by 2023.

Owing to its former use, the Proposal Site is a highly disturbed industrial landscape, in a relatively isolated location surrounded by forest and rural or semi-rural land uses. The land is generally flat and lies at the edge of the extensive Hunter River floodplain. The Hunter River flows through the town of Maitland approximately nine km north east of the Proposal Site. Surrounding land uses consist of scattered rural residential dwellings, light industry, a TAFE college, utilities (wastewater treatment plant, electricity easements and substation), a speedway, and rural land. The nearest dwelling is situated at Loxford, just over one km south east of the Proposal Site.

There is a rezoning master plan proposal by ReGrowth Kurri Kurri, to rezone and re-subdivide land owned by Hydro Aluminium including the Proposal Site, the remainder of the former Kurri Kurri aluminium smelter site, and some surrounding land. The objective of the proposed rezoning is to promote development for a mixture of new land uses including industrial, commercial, recreation and residential, with a new industrial estate at its core. The Proposal Site would be situated in this industrial estate and would likely be rezoned as IN3 – Heavy Industry. A gateway determination for the rezoning proposal was granted by the NSW Department of Planning, Industry and Environment (DPIE) on 1 December 2020 and the plans were exhibited for public comment until 1 February 2021. Pending further reporting and resolution by Cessnock and Maitland Councils, which share planning jurisdiction over the land, the rezoning proposal will proceed to preparation of draft amendments to the Cessnock and Maitland local environmental plans, which will again be publicly exhibited before the Minister for Planning and Public Spaces makes a final decision to approve the rezoning.

As a former industrial site, on land that is already highly disturbed, with ready access to existing high voltage overhead electricity infrastructure, a major transport artery and gas transmission system, and with few if any sensitive land uses nearby, the Proposal Site is considered to be ideally suited for the proposed development.

The Proposal is considered a compatible use of this land and does not conflict with ongoing operations or existing surrounding land uses. Further, the Proposal is considered to be consistent and compatible with likely future land uses surrounding the Proposal Site, under the proposed rezoning master plan by ReGrowth Kurri Kurri that is currently under consideration by the DPIE and Cessnock City Council.

E.4. Statutory context

The Proposal Site is located within the Cessnock local government area and is currently zoned RU2 Rural Landscape under the Cessnock Local Environmental Plan 2011 (LEP). The Proposal is classified as development that would be permitted with consent in the RU2 zone.

On 16 December 2020 the Minister for Planning and Public Spaces declared that the Proposal is critical State significant infrastructure (CSSI) under Section 5.13 of the NSW *Environmental Planning and Assessment Act 1979*. As such, the Proposal is considered to be "essential for the State for economic, environmental or social reasons", and is listed under clause 16 and Schedule 5 of State Environmental Planning Policy (State and Regional Development) 2011. The land use and permissibility requirements under the Cessnock LEP therefore do not apply to the Proposal, and hence it is to be assessed and determined under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979*.

The Proposal has been referred to the Commonwealth Department of Agriculture, Water and the Environment (DAWE), under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). On 30 March 2021 DAWE notified Snowy Hydro that the Proposal is "an action taken by a Commonwealth agency that is likely to have a significant impact on the environment." The DAWE concluded that, based on the information provided in the referral, "the proposed action is likely to have a significant impact on the environment, including but not limited to:

- generating emissions and pollutants which may impact air quality, and
- potentially disturbing contaminated and/or acid-sulphate soils in the proposed action area with potential flow on impacts to surface or ground water."

The Proposal is therefore a controlled action, and requires Australian government approval, in accordance with the EPBC Act. The Proposal has been assessed in accordance with the bilateral agreement made between the Commonwealth and the NSW Government, and this EIS therefore satisfies the environmental assessment requirements under the EPBC Act.

The Environmental Impact Statement (EIS) has been prepared to address the Secretary's Environmental Assessment Requirements (SEARs) issued by the DPIE on 5 February 2021. The EIS focuses on key issues of biodiversity, heritage, hazards, land, noise, air quality, transport, water, socio-economic, visual and waste impacts. The EIS has not identified any issues or predicted any significant impacts that would preclude approval of the Proposal by the Minister.

A summary of the findings from the assessment of key issues identified in the SEARs is provided in the following sections.

E.5. Social, cultural and amenity impacts and benefits

The Proposal would have few localised social impacts, but would result in local and regional benefits including a direct and indirect boost to local employment. Construction of the Proposal would generate up to approximately 250 full time equivalent positions at the peak of construction activity, and about 10 permanent full time equivalent jobs on site during operation. A small number of additional support staff and deliveries of consumables, waste disposal, sanitary services, and specialist maintenance staff may also be generated. The provision of goods and services to the Proposal throughout its operational life would generate increased economic activity for local and regional businesses.

While the Proposal would generate additional traffic during construction, the likely volumes of construction traffic would be within the capacity of the local road network and would not result in delays at existing intersections. Similarly, noise associated with construction traffic has been assessed as unlikely to impact on amenity of local residents or accessibility.

The Proposal would generate noise during operation and would be audible to receivers in the vicinity of the Proposal Site. However, the noise modelling of the Proposal indicated that sensitive receivers in the vicinity of the Proposal Site would not be subjected to operational noise in excess of residential noise criteria as regulated by the NSW Environment Protection Authority. Similarly, operational noise levels at proposed future neighbouring industrial sites would comply with the noise criteria for non-sensitive receivers.

The Proposal would introduce a new facility which would be visible from a small number of existing viewpoints in the surrounding area. However, at approximately 36 m, the height of the two turbine exhaust stacks would be considerably lower than the 140 m and 70 m chimneys that were associated with the former Kurri Kurri aluminium smelter. The visual impact is considered low to negligible due to the existing industrial landscape character and sensitivity and limited visibility and distance from accessible viewpoints.

Additional workers during construction of the Proposal may require accommodation but this should not exceed the capacity of the local surrounding townships. Positive social and economic impacts would include the flow-on effects of those workers accessing goods and services in the region, and overall increase in reliability of the National Energy Market.

The Proposal would not result in any impacts on known items or places of historic cultural heritage significance.

An assessment of Aboriginal cultural heritage has been undertaken in consultation with local registered Aboriginal parties (RAPs), including site surveys. The site surveys did not result in any findings of likely cultural or archaeological significance, reflecting the Proposal Site’s history of use and the level of disturbance. However, it is recognised that during construction, deep excavations into alluvial soil layers may have the potential to disturb cultural artefacts. Recommended mitigation measures therefore include a requirement for an archaeologist and representative of the RAPs to monitor these excavation works, record any finds, and remove items for off-site analysis and storage.

E.6. Biophysical impacts and benefits

The Proposal has avoided biodiversity impacts to the greatest extent possible and would require the clearing of only 1.54 ha of native vegetation. However, just 0.41 ha of this native vegetation is classed as ‘intact’. The remainder is regrowth or ground layer vegetation that is within existing power line easements and subject to regular slashing and maintenance. These impacts would be offset in accordance with the NSW *Biodiversity Conservation Act 2016* and in accordance with any approval conditions. No significant impacts on threatened species or communities are predicted.

Stormwater management during construction and operation would be designed to prevent unfiltered runoff entering local creeks and waterways that discharge into the floodplain of the Hunter River. The Proposal Site is above the probable maximum flood levels and due to the proposed stormwater detention basin, the flood peaks after development are anticipated to be less than existing peaks. Impacts to downstream aquatic systems including groundwater dependant ecosystems are not anticipated.

The Proposal’s operation would generate air pollutant emissions from the combustion of natural gas and diesel fuel. Both of these fuel sources generate emissions of carbon monoxide, carbon dioxide (CO_2), nitrogen oxides, sulphur oxides, suspended particulate matter (such as PM_{10} and $PM_{2.5}$), and unburnt hydrocarbons and other volatile organic compounds. Snowy Hydro has considered the technologies available for controlling emissions from gas turbine plants, and assessment has shown that the best available and appropriate control technology for these units is to utilise Dry Low Emissions burners when operating on natural gas fuel, and using Water Injection control technology when operating on diesel fuel. With the application of the above emissions control technology, air quality modelling demonstrated that the emitted concentrations of all airborne substances and particulate matter would be low and not expected to cause adverse air quality impacts in the vicinity of the Proposal Site nor in the region, and would not cause any additional exceedances of EPA criteria.

A greenhouse gas (GHG) assessment was conducted in accordance with National Greenhouse Accounts guidance, to estimate GHG emissions for the construction and operational phases of the Proposal, and the operational phase GHG emissions compared to the overall energy output of the Proposal. The operational phase emissions were calculated as 500,299 tonnes of CO_2 equivalent per annum. Taking into account its annual energy output, the Proposal would have an emission intensity of approximately 0.52 tonnes CO_2 equivalent/MWh (Scope 1 + 2).

The Proposal Site has been included in the recent and ongoing extensive remediation process for the former Kurri Kurri aluminium smelter site. As a result, Snowy Hydro will take possession of the Proposal Site after completion of a site audit statement, prepared by an EPA accredited site auditor, stating that the land is suitable for Heavy Industrial use and zoning in accordance with the proposed Rezoning Master Plan by ReGrowth Kurri Kurri. This means that prior to any construction, the Proposal Site is required to be remediated and validated, and based on this, the Proposal would give rise to negligible risk to human health or the environment due to exposure to legacy contamination.

E.7. Hazards and risk

A preliminary hazard assessment considered the Proposal's operating hazards and risks, as well as hazards associated with bushfire prone land, plume rise (aviation hazard), and electric and magnetic fields. At this stage of the Proposal's design, a number of hazard control measures and risk treatments have been included, to benefit safety and mitigate harm. These include:

- Locating the Proposal on a 'brownfield' industrial site, removed from sensitive land uses, on land identified for future heavy industry, on the edge of a future industrial estate and adjoining undeveloped rural bushland
- Positioning of the gas turbines and gas receiving station within the Proposal Site to provide maximum separation distance to future nearby industrial developments
- Provision of a buffer zone extending south from the actual power station footprint
- Minimising dangerous goods and hazardous chemical transport, storage and handling at the Proposal Site
- Allowance for a 10 m asset protection zone as part of bushfire hazard reduction, as well as controls for bushfire fuel reduction and restrictions on certain construction activities taking place on total fire ban days.

The preliminary hazard assessment investigated the thermal radiation and overpressure effects of the Proposal's low pressure gas systems. The consequences of a jet fire (where the gas ignites at the moment that the pipeline is ruptured) from the Proposal as well as the overpressure from a gas cloud explosion (where the gas accumulates in a cloud for up to about two minutes and then ignites) would not extend beyond the Proposal Site boundaries, except on the western boundary with adjoins rural bushland. No sensitive land uses would be impacted and the Proposal is not expected to significantly impact surrounding land use safety.

The inclusion of a 10 m asset protection zone between the bushfire prone land and the infrastructure, combined with design that considers radiant heat and ember exposure, would mitigate bushfire risks.

The aviation risk assessment identified a potential hazard associated with plume velocity from the Proposal's turbine exhaust stacks. In accordance with Civil Aviation Safety Authority (CASA) requirements, the assessment concluded that while all power station gas turbine exhaust plumes can potentially be a hazard to aviation, the risk from the Proposal is small. Consultation with pilots and other stakeholders confirmed that the Proposal would not be hazardous to local aviation, as long as pilots know the location of the Proposal and can readily identify when the power station is operating. Mitigation measures therefore include suitable marking of all published aeronautical navigation charts, and incorporation of lighting on gas turbine exhaust stack structures, to be activated during operations.

The assessment of electric and magnetic fields showed that the Proposal would not present a risk to the public as exposure risk decreases rapidly with distance from the source, and all new electrical components would not be publicly accessible. The Proposal is not likely to restrict the types of development compatible with the current or proposed future land use zoning, as a result of EMF emissions.

E.8. Justification

Variable renewable or intermittent energy generation, such as wind and solar, is not able to be dispatched whenever needed and at the capacity that is needed. In order to provide a reliable supply of energy, intermittent energy generation needs to be 'firmed' or backed up with some form of dispatchable power generation or energy storage to guarantee supply at the capacity that is needed. Until such time that sufficient energy storage systems can meet the balancing of electricity generation and consumption across hours, days and seasons, generation capacity using other technologies will need to be provided to meet system objectives for reliability and security of supply.

Apart from traditional forms of dispatchable power generation (such as baseload coal-fired generation), power generation system reliability can now be achieved in two main ways: grid scale battery or hydro-electric storage, or fast-start dispatchable or peaking generation such as open cycle gas turbines. Batteries are inherently limited by their storage capacity (megawatt hours or MWh) relative to their MW capacity, dictating how long they can operate in a single continuous period of generation. Energy storage systems such as those using hydrogen are not presently economical. Conversely, a peaking power station using natural gas virtually has no restriction on when it can produce dispatchable energy within a day, and the duration for which it can continuously provide that energy across that day.

The objective of the Proposal is to provide dispatchable capacity and other services into the NEM, and to meet demand when the needs of electricity consumers are highest. Although a combination of grid-scale batteries and fast-start gas turbines could provide these capabilities, gas fuelled peaking generation is considered to be best suited, as it provides an increased level of energy reliability to the NEM primarily through provision of firming capacity over extended periods, as and when required. The Proposal would operate in conjunction with the various forms of energy storage (such as batteries), as these are further developed in the NEM.

Without dispatchable and firming generation or grid scale storage, a power system that is solely reliant on intermittent renewable generation will have unacceptable levels of customer supply failure. Therefore, the Proposal is a vitally important component in the transition to renewable energy, and would ultimately benefit the environment and future generations by facilitating the displacement of carbon based electricity generation.

The Proposal represents an estimated $610 million investment by Snowy Hydro, aimed at increasing reliability of the National Energy Market through the provision of dispatchable electricity and other network services. The Proposal is being designed and implemented to maximise its value from both an economic and social perspective. The Proposal is achieving environmental goals through the beneficial reuse of industrial land, thus requiring a minimum of new disturbance, having negligible impact on amenity, and hence largely avoiding impacts while maximising benefits.

E.9. Summary and conclusion

The EIS provides a description of the Proposal, an explanation of the need for the Proposal, existing information on environmental context, the potential for environmental impacts and recommended mitigation measures. The EIS has been prepared to address the SEARs issued by the NSW DPIE and focuses on key issues. In addition, the EIS summarises consultation undertaken with agencies and the public and provides information that responds to the issues and concerns raised. The overall Proposal benefits, including dispatchable electricity and other network services, are considered to outweigh the limited environmental and social impacts identified.

Contents

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List of tables

Statement of validity

Details	Hunter Power Project (Kurri Kurri Gas Fired Power Station Project)
Applicant name	Snowy Hydro Limited
Applicant address	Monaro Highway, Cooma, NSW 2630
Land to be developed	73 Dickson Road, Loxford NSW 2326
Formal identifier	▪ Part Lot 319 DP 755231 ▪ Part Lot 769 DP 755231
Proposed development	SSI-12590060 – Development for the purposes of the Hunter Power Project (Kurri Kurri Gas Fired Power Station Project) being a gas fired power station comprising: ▪ Two heavy-duty F-class open cycle gas turbines, generator circuit breakers and generator step-up transformers ▪ 132 kV Electrical switchyard comprising circuit breakers, bus-bars, isolators, series reactor and switchyard equipment including either underground cables or overhead line support gantries between the power station and the switchyard ▪ Associated balance of plant infrastructure including water and diesel storage tanks; internal roads and loading/unloading facilities; concrete bunded areas for fuel/chemical storage; control room and site office/amenities/workshop; stormwater/wastewater drainage systems; emergency diesel generators; security and communications systems ▪ Direct connection to existing Ausgrid overhead 132 kV transmission lines.
Prepared by	Jacobs Group (Australia) Pty Ltd
Address	Level 7, 177 Pacific Highway North Sydney, NSW 2060
Author	Mike Luger MPhil Sci (Environmental and Geographical Science)
In respect of	SSI-12590060
Certification	I certify that I have prepared the contents of the Environmental Impact Statement in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* and the Secretary's Environmental Assessment Requirements dated 5 February 2021. This Environmental Impact Statement contains all available information that is relevant to the environmental assessment of the development and to the best of my knowledge the information contained in the Environmental Impact Statement is not false or misleading.
Signature	
Name	Mike Luger
Date	22 April 2021

Glossary of terms and abbreviations

Terms and abbreviations	Description and definitions
AAR	Aboriginal Archaeological Report
ABS	Australian Bureau of Statistics
ACHAR	Aboriginal cultural heritage assessment report
ACHCRP	Aboriginal Cultural Heritage Consultation Requirements for Proponents
ACT	Australian Capital Territory
AEC	Area of environmental concern
AEMO	Australian Energy Market Operator
AEP	Annual Exceedance Probability
AFG	Aboriginal Focus Group
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AAR	Aboriginal Archaeological Report
AHIP	Aboriginal Heritage Impact Permit
Airports Act	*Airports Act 1996*
Airports Regulation	Airports (Protection of Airspace) Regulation 1996
ALARP	As low as reasonably practicable
APZ	Asset Protection Zone
ARI	Average recurrence interval
ARPANSA	The Australian Radiation Protection and Nuclear Safety Agency
ASC	Australian Soil Classification
ASS	Acid Sulphate Soils
BAM	Biodiversity Assessment Method
BCA	*Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
BFMCs	Bush Fire Management Committees
BPL	Bushfire-prone land
CASA	Civil Aviation Safety Authority
CCTV	Closed-circuit television
CEMP	Construction Environmental Management Plan
CEMS	Continuous Emission Monitoring Systems
CH_4	Methane
CHL	Commonwealth Heritage List
CO	Carbon monoxide
CO_2	Carbon dioxide

Terms and abbreviations	Description and definitions
CONCAWE	Conservation of Clean Air and Water in Europe
CPH	Critical plume height
CPV	Critical plume velocity
CSSI	Critical State Significant Infrastructure
CTMP	Construction Traffic Management Plan
CWMP	Construction Waste Management Plan
D600	A military danger area
DAWE	Department of Agriculture, Water and the Environment
dB(A)	Decibel; A-weighted, approximates the sensitivity of the human ear
DEC	Department of Environment and Conservation
DECCW	Department of Environment, Climate Change and Water
DGVs	Default guideline values
DLE	Dry Low Emission
DP	Deposited Plan
DPIE	Department of Planning, Industry and Environment
EESG	NSW Environment, Energy and Science Group
EMF	Electric and magnetic fields
ENM	Excavated Natural Material
EOH	Equivalent operating hours
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment protection Authority (NSW)
EPA Regulation	Environmental Planning and Assessment Regulation 2000
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPI	Environmental Planning Instruments
ES(SNM) Regulation	Electricity Supply (Safety and Network Management) Regulation 2014
ESA	*Electricity Supply Act 1995*
ESA	Environmental Site Assessment
ESB	Energy Security Board
ESCP	Erosion and sediment control plan
ESOO	An Electricity Statement of Opportunities
EST	Energy security target
FDR	Fire danger ratings
FFDI	Forest fire danger index
FTE	Full time equivalent
Gas lateral	Branch pipeline to connect the main Sydney-Newcastle gas pipeline to the Proposal Site (not yet built)

Terms and abbreviations	Description and definitions
GDE	Groundwater Dependent Ecosystems
GFS	Global Forecast System
GHG	Greenhouse gas
GIS	Geographic Information System
GJ	Gigajoules
GLC	Ground level concentrations
GPS	Global Positioning System
GRP	Glass reinforced polymer
GSUT	Generator Step Up Transformer
GT	Gas turbine
GTG	Gas Turbine Generator
H_2N_4	Hydrazine
HSEMS	Health and Safety Environmental Management System
Hz	Hertz
ICNG	Interim Construction Noise Guideline
ICNIRP	International Commission on Non-Ionising Radiation Protection
IFR	Instrument Flight Rules
IHS	Inner Horizontal Surface
ILUA	Indigenous Land Use Agreement
Important Areas Map	Important parts of the landscape for specific threatened species as identified by experts based on evidence-based criteria (e.g. breeding or roosting records, habitat features, landforms or existing mapping) and included in the NSW regulatory framework for biodiversity
IRM	Interim Reliability Measure
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
ISP	Integrated System Plan
kV	kilovolt
LALCs	Local Aboriginal Land Councils
LEP	Local Environment Plan
LGA	Local Government Area
LLS	Local Land Services
ML	Megalitre
MNES	Matters of National Environmental Significance
MPa	Megapascals
MSA	Minimum Sector Altitudes
MUMBA	Measurements of Urban, Marine and Biogenic Air

Terms and abbreviations	Description and definitions
MW	Megawatt
N_2O	Nitrous oxide
Native Title Act	*Native Title Act 1993*
NCAs	Noise Catchment Areas
NEM	National Electricity Market
NER	National Electricity Rules
NH_3	Ammonia
NHL	National Heritage List
NHVR	National Heavy Vehicle Regulator
NNTT	National Native Title Tribunal
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NPI	National Pollutant Inventory
NSP	Network Supply Provider
NVIA	Noise and Vibration Impact Assessment
O_3	Ozone
OCGT	Open Cycle Gas Turbine
OEH	Office of Environment and Heritage
OEMP	Operational Environment Management Plan
OLM	Ozone Limiting Method
OLS	Obstacle Limitation Surface
OOH	Outside of hours; outside recommended standard hours
OSOM	Oversize overmass (heavy vehicle transport)
OWMP	Operational Waste Management Plan
PAD	Potential archaeological deposit
PAH	Polycyclic Aromatic Hydrocarbons
PANS-OPS	Procedures for Air Navigation Standards – Operations
PAS	Potential archaeological sensitivity
PCT	Plant Community Types
PFAS	Per- and polyfluoroalkyl substances
PHA	Preliminary hazard analysis
PHES	Pumped hydro energy storage
PM_{10}	Airborne particulate matter 10 micrometres or less in diameter
$PM_{2.5}$	Airborne fine particles 2.5 micrometres or less in diameter
PMF	Probable Maximum Flood

Terms and abbreviations	Description and definitions
PMST	Protected Matters Search Tool
POEO Act	*Protection of the Environment Operations Act 1997*
ppm	Parts per million
QNI	Queensland to New South Wales Interconnector
R578F	A military restricted airspace zone
RAAF	Royal Australian Air Force
RAP	Remedial Action Plan
RAPs	Registered Aboriginal Parties
RBL	Rating Background Level
REZ	Renewable energy zone
RFS	Rural Fire Service
RMS	Root Mean Square
RNAC	Royal Newcastle Aero Club
RNP	Road Noise Policy
RRO	Retailer Reliability Obligation
SAA	Seen area analysis
SDSs	Safety Data Sheets
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SF_6	Sulphur hexafluoride
SFAZ	Strategic Fire Advantage Zone
SH	Standard hours
SEIA	Socio-economic impact assessment
SEPP	State Environmental Planning Policy
SO_2	Sulphur dioxide
SSD	State Significant Development
SSI	State Significant Infrastructure
SU	Survey Unit
TAPM	The Air Pollution Model
TBDC	Threatened Biodiversity Data Collection
TEC	Threatened Ecological Communities
TKN	Total Kjeldahl Nitrogen
TN	Total nitrogen
TOBANs	Total fire bans
TP	Total phosphorus

Terms and abbreviations	Description and definitions
TPH	Total Petroleum Hydrocarbons
USE	Unserved energy
VDV	Vibration dose values
VENM	Virgin excavated natural material
VFR	Visual flight rules
VNC	Visual Navigation Chart
VRE	Variable renewable energy
WI	Water Injection
WM Act	*Water management Act 2000*
WSP	Water Sharing Plan
ZVI	Zones of visual impact

1. Introduction

1.1 Proposal overview

Snowy Hydro Limited (Snowy Hydro, the 'Proponent') proposes to develop a gas fired power station near Kurri Kurri, NSW (the Hunter Power Project; or the Proposal; formerly referred to as the Kurri Kurri Power Station Project). Snowy Hydro is seeking approval from the NSW Minister for Planning and Public Spaces under the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) for the Proposal. The location of the Proposal Site is shown in Figure 1.1.

The Proposal involves the construction and operation of a power station and electrical switchyard, together with other associated infrastructure. The power station is expected to have a generation capacity of up to approximately 750 megawatts (MW), generated by two industrial frame heavy duty F-Class gas turbine units in Open Cycle Gas Turbine (OCGT) configuration. The gas turbines would primarily be fired on natural gas with the use of diesel fuel as a backup. A detailed description of the Proposal is provided in Chapter 1.6.2.

The Proposal will operate as a "peak load" generation facility supplying electricity at short notice when there is a requirement in the National Electricity Market (NEM). The major supporting infrastructure required for the Proposal would be a 132 kV electrical switchyard located within the Proposal Site. Also required is a new gas lateral pipeline and gas receiving station (which would be developed by a third party and subject to a separate planning approval). The Proposal would connect into existing 132 kV electricity transmission infrastructure located adjacent to the Proposal Site.

The main components of the Proposal would include:

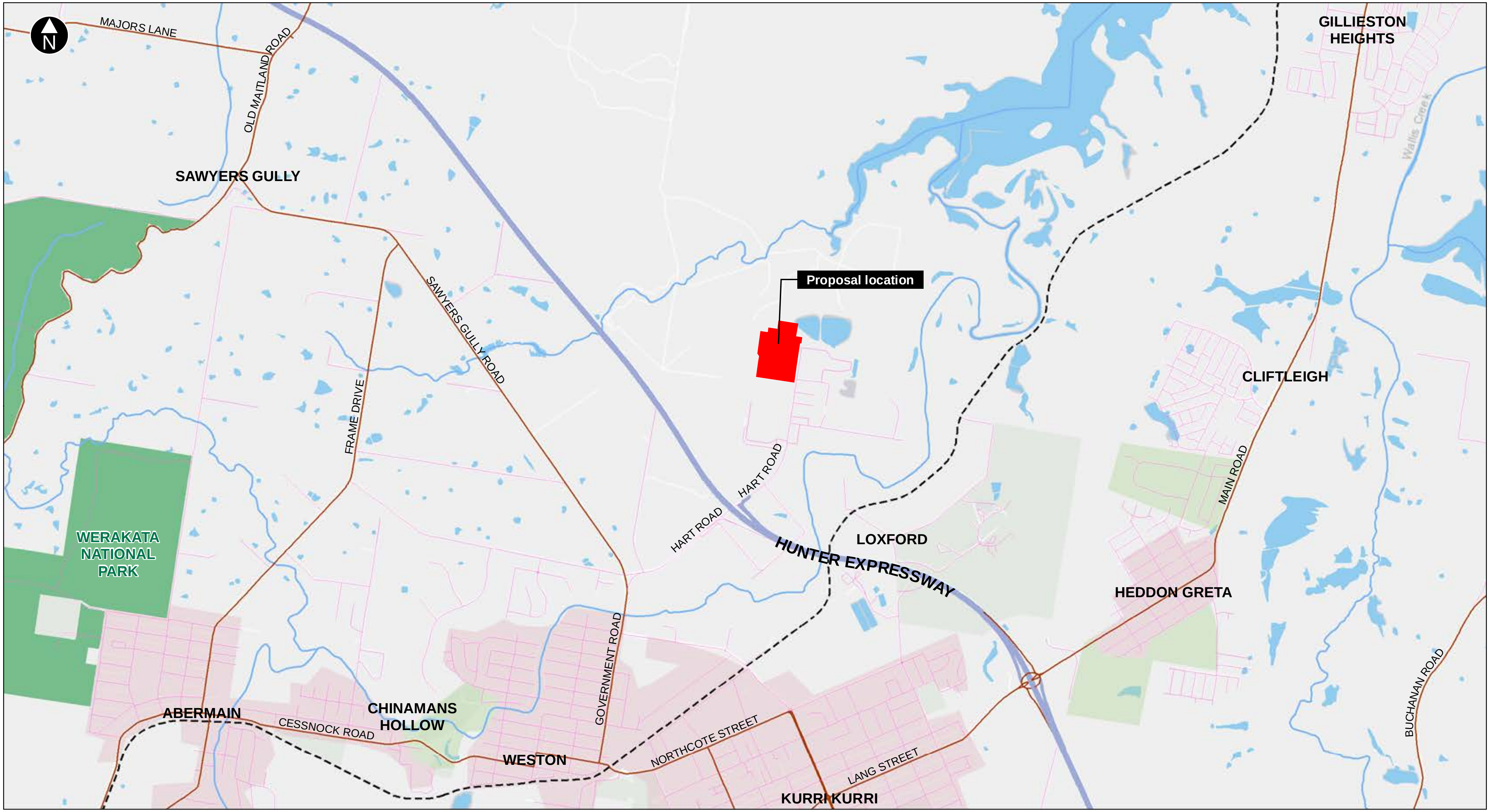
- Two OCGTs and all associated balance of plant infrastructure required for an operating power station, with commissioning proposed to be in the second half of 2023, nominally between August and December.
- A 132 kV electrical switchyard adjacent to the power station and connection into the existing 132 kV network.

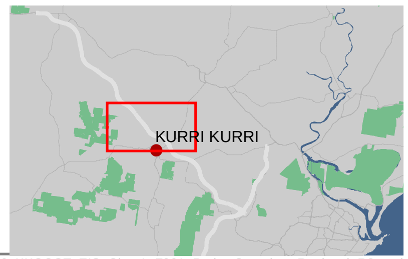
The proposed switchyard would operate at a voltage of 132 kV, with the exact switchyard arrangement yet to be finalised. The generators' step-up transformers would be located within the power station boundary which would step up the generated voltage to 132 kV for connection into the NEM. The electrical switchyard would eventually be operated by a nominated Network Service Provider (NSP). The local NSP is Ausgrid, the owner and operator of the wider 132 kV, 66 kV, 33 kV and 11 kV electrical network in the area surrounding the Proposal Site. The electrical network immediately surrounding the Proposal Site is 132 kV and 33 kV.

The Proposal seeks to connect at a voltage of 132 kV. Multiple existing 132 kV transmission lines would exit the electrical switchyard and eventually connect into the Kurri Zone Substation and the Newcastle Terminal Station.

The Proposal would be fully automated, with power station operations to be monitored and controlled from both the Site and from the Snowy Hydro's existing Control Centre in Cooma, NSW.

Figure 2.1 shows the main components of the Proposal and their planned configuration on the Proposal Site. The configuration is subject to final detailed design.





Proposal location

National Parks and Wildlife Services estate / reserve

Recreation areas

Urban areas

Waterbodies

Motorway

Main roads

Roads

Railway

0 1 2 km

1:40,000 at A4

Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs
NSW Spatial Services

Figure 1-1 Proposal location (regional)

For gas operation, the Proposal would require connection to a new gas lateral and storage pipeline, which would connect into the existing Sydney to Newcastle Jemena Gas Networks (JGN) Northern Trunk gas transmission pipeline, with the tie in point to be located within the proximity of the Newcastle area. This new gas lateral pipeline would be developed, constructed and operated separately to this Proposal (by others) but would be required for the power station to operate. Gas would be supplied to the power station from Australia's existing gas fields that feed Sydney and Newcastle via the existing NSW gas transmission system.

The Proposal has a capital cost of approximately $610 million. The development is anticipated to be operational by the end of 2023.

1.2 Proponent

Snowy Hydro Limited was created when the Snowy Hydro-Electric Authority was corporatised in 2002 by then shareholding Commonwealth, New South Wales and Victorian governments. The Commonwealth government became the sole shareholder in 2018 when the New South Wales and Victorian governments sold their shareholding. Since its inception in 1949, Snowy Hydro has established the Snowy Mountains Hydro-electric Scheme and evolved into an end-to-end energy provider.

Snowy Hydro is 100 per cent owned by the Australian Commonwealth Government, operates as a corporate entity, and is governed by an independent Board of Directors. Snowy Hydro's role in the energy market today is to:

- Generate energy that underpins the security and reliability of the NEM
- Underpin the transition to renewable energy
- Provide price risk management products for wholesale customers
- Increase competition in the energy markets
- Generate electricity that is delivered to homes and businesses
- Provide retail electricity and gas supplies through retail businesses, Red Energy and Lumo Energy.

Snowy Hydro employs nearly 2000 people across Australia, including more than 1200 people in the Red Energy and Lumo Energy retail businesses.

Snowy Hydro has a portfolio of power generation assets including the Snowy Scheme hydro power stations along with gas and diesel-fired peaking power stations. In total, Snowy Hydro has 16 power stations and more than 5,500 MW of generating capacity across New South Wales, Victoria and South Australia. Snowy Hydro has also recently expanded its renewable portfolio to include contracted energy with 10 wind and solar projects.

Aside from the Snowy Mountains Scheme in southern NSW, Snowy Hydro owns and operates two gas fired power stations in Victoria: a 320 MW two-unit dual-fuel open cycle gas turbine facility at Laverton North, and a 300 MW station comprising six 50 MW dual-fuel open cycle gas turbines in the Latrobe Valley.

In NSW, Snowy Hydro owns and operates the Colongra Power Station on the Central Coast. Colongra comprises four dual-fuel open cycle gas turbines and has a total generating capacity of 667 MW. The natural gas to fuel the turbines is supplied from the existing Sydney-Newcastle gas pipeline.

Snowy Hydro's retail electricity and gas businesses deliver energy supplies to more than one million customers in Victoria, New South Wales, ACT, south-east Queensland and South Australia.

1.3 Proposal history and need

Over the past decade there has been a progressive movement towards the retirement of large thermal power stations, particularly coal fired power stations, as more renewable energy generators (particularly wind and solar) appear in the NEM. More recently the Hazelwood Power Station in Victoria was retired and decommissioned (in 2017), Energy Australia has announced the closure of Yallourn in 2028, and AGL has announced that the coal-fired power station at Liddell in NSW will be retired in stages, with one unit to shut down in April 2022 and the remaining three units in April 2023 (AGL, 2020).

Dispatchable electricity and other network support services are increasingly being required and deemed critically important to the stability of the NEM as more intermittent renewable energy generators enter the market. The Proposal would function as a source of dispatchable electricity into the NEM and would be one of the mechanisms available to the Australian Energy Market Operator (AEMO) to respond to electricity demand following retirement of the Liddell Power Station.

A detailed discussion of the strategic policy framework, and the need and justification for the Proposal is provided in Chapter 4.

1.4 Site and surrounds

The Proposal Site address is 73 Dickson Road, Loxford. Access to the property is via Hart Road and the property is approximately 1.0 km from the M15 Hunter Expressway as shown in Figure 1.2.

The Proposal Site would be part of a proposed Industrial Estate development.

The proposed rezoning and subdivision around and including the Proposal Site (see Chapter 4 Section 4.4.4) would likely result in a new land use zoning and property description applying to the Proposal Site. The Proposal Site is currently described as Part Lot 319 and Part Lot 769 in Deposited Plan (DP) 755231, in the City of Cessnock Local Government Area (LGA). The planning proposal, currently under consideration by Cessnock City Council and the NSW Department of Planning, Industry and Environment, would rezone the Proposal Site as Heavy Industrial. The Proposal Site and its surrounds are currently zoned RU2 Rural Landscape under the Cessnock Local Environmental Plan 2011 (Cessnock LEP), with small pockets of surrounding land zoned E2 Environmental Conservation, as shown in Figure 1.3. Further details regarding the planned rezoning and subdivision are provided in Chapter 4.

Proposal Site
Detention basin
Existing electrical transmission easement

Motorway
Main roads
Roads
Railway
Waterbodies

① Proposed Switchyard Area
② Proposed Plant Area
③ Proposed Buffer Area

0 250 500 m

1:12,000 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 1-2 Proposal location (local)

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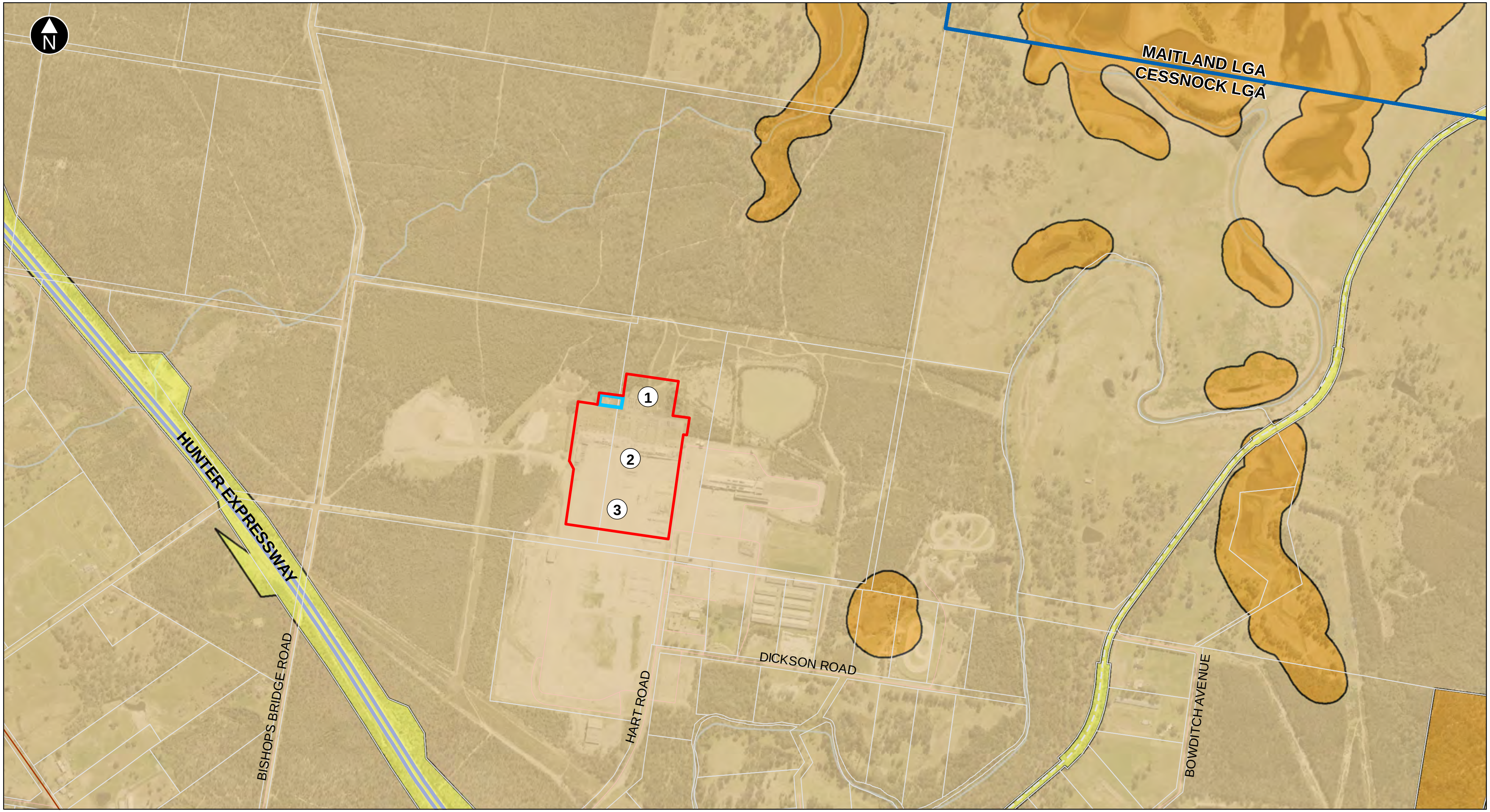

Proposal Site
Detention basin
Cadastre
Motorway
Main roads
Roads
Railway
Local Government Area

Land use zones
E2 Environmental Conservation
RU2 Rural Landscape
SP2 Infrastructure

1 Proposed Switchyard Area
2 Proposed Plant Area
3 Proposed Buffer Area

0 0.5 1 km

1:15,000 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs 2020
NearMap 2020
NSW Spatial Services

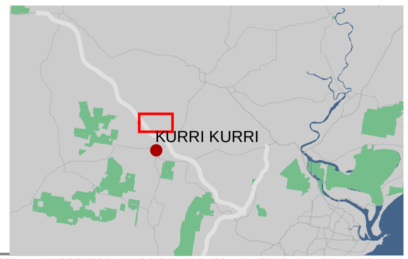

Figure 1-3 Current land use zones

snowy hydro renewable energy Jacobs

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The Proposal Site forms part of the former Hydro Aluminium Kurri Kurri Pty Ltd (Hydro Aluminium) aluminium smelter, which operated from 1969 to late 2012 and was closed in 2014. The existing aluminium smelter property currently remains in Hydro Aluminium ownership, while the demolition of the smelter is well progressed. This includes the existing electrical switchyard of the former aluminium smelter and part of the smelter site, which will also be fully decommissioned and removed prior to the construction of the Proposal.

Since the closure of the smelter and following its progressive demolition, extensive remediation works have taken place at the site, including Stage 1 of a two-stage program of removal of existing structures, asbestos removal and recycling of waste materials. Before any construction commences for the Proposal, the demolition and remediation works will have been completed by the previous owners to a standard suitable for subsequent industrial use. This includes Stage 2 demolition works, further remediation and the demolition of below ground infrastructure in accordance with conditions of approval issued by the Minister for Planning.

The Proposal Site's current condition is that of a brownfield site, extensively disturbed by past industrial development. As such the Proposal would require minimal new disturbance of undisturbed land. The surrounds are primarily flat, with natural drainage falling gradually to the north-east towards Black Waterholes Creek. There are two large, shallow artificial ponds located north-east of the Proposal Site, which were constructed to capture stormwater runoff from the smelter site and are integrated with the natural drainage regime. These ephemeral ponds currently overflow and discharge as irrigation to the adjacent paddock (owned by Hydro Aluminium) north of the Proposal Site.

Snowy Hydro has made arrangements to acquire the land required for the Proposal. The objective for the former smelter site is for it to be rezoned and prepared as an estate suitable for subsequent industrial uses, including the land identified for the Proposal site.

Snowy Hydro will therefore take possession of the Proposal Site as predominately cleared, vacant land. The site has been chosen and planned to incorporate the gas turbine(s), transformers, balance of plant equipment, storage tanks, office and workshop facilities, switchyard and an adjoining buffer zone.

The closest residential zoned land is the suburban areas of Kurri Kurri, located approximately 2.5 km south and south-west of the Proposal Site. Further residential areas at Heddon Greta and Cliftleigh are situated approximately 2.5 km to the east. There are some sparse rural residential properties south and south-east of the Proposal Site, the nearest being located on Dawes Avenue, Loxford which is approximately 1.15 km south-east of the Proposal Site. The Kurri Kurri Speedway Club is on Dickson Road, Loxford and is approximately 800 m south-east of the Proposal Site.

There is native vegetation adjacent to the Proposal Site in the north, east and west. Land further east and north of the Proposal Site comprises low-lying open rural land on the fringe of the Hunter River floodplain approximately 9 km south west of the Hunter River. The Proposal Site is on the fringe of the Hunter River floodplain and is also surrounded by the following watercourses:

- A tributary of Black Waterholes Creek, located immediately to the west of the Proposal Site, which flows from south to north
- Swamp Creek, located 900 m to the east of the Proposal Site, which flows in a northward direction
- Both Black Waterholes Creek and Swamp Creek drain to Wentworth Swamp about 1.5 km north of the Proposal Site, which drains to the Hunter River at Maitland.

Peak flood depths at the Proposal Site are dictated by Hunter River flooding, rather than flooding from Black Waterholes Creek and Swamp Creek. The former smelter site, and consequently the Proposal Site is raised such that the site is above, and therefore not at risk from, the Hunter River's probable maximum flood level.

1.4.1 Site selection

The ability to re-use land previously occupied by heavy industry is integral to the selection of the Proposal Site. Similarly, the 132 kV high voltage transmission lines which provided the connection for the former Hydro Aluminium smelter to the broader electricity network would be re-used for the Proposal. In combination, these attributes favour the industrial re-purposing of the Proposal Site and make it the preferred location for a new gas fired power station.

In addition to these key benefits, the attributes which identified the location as suitable for a power station were as follows:

- The Proposal Site is a predominately cleared, disturbed brownfield site, which minimises the Proposal's overall impact on the environment
- The Proposal Site is removed from densely populated areas and sensitive neighbouring land uses
- Proximity to major gas supply pipelines, in a geographical area of the gas network that has potential growth
- Proximity to existing high voltage electricity transmission network and high electricity demand centres
- Capacity of the electrical transmission network to receive and transport electricity produced without constraint
- Availability of suitable and suitably zoned land with compatible existing land use
- Availability of the site at the time of the development need and forecast electricity market demand
- Access for the delivery of heavy construction loads and ongoing liquid fuel transport routes
- Availability of skilled construction and operations workforce
- Proximity to centres for operational maintenance resourcing
- Ready availability of water and wastewater facilities
- Local businesses and infrastructure sufficient to support a power station.

Key site selection parameters included environmental, infrastructure, economic, engineering, and land use constraints and opportunities. The Proposal Site was selected because it best satisfies the criteria for a gas fired power station and its ancillary infrastructure needs, while minimising the potential for environmental and social impacts.

1.5 Proposal objectives

The Proposal aims to increase Snowy Hydro's power generation portfolio, through a commercially viable project that principally provides gas fired generation capacity to firm renewable energy generation's intermittent electricity supply to the NEM. This additional dispatchable and firming generation, together with the NEM's increasing adoption of intermittent renewable generation, will provide a reliable supply of electricity to the customer. This is discussed further in Chapter 4.

The key operational and functional objectives of the Proposal are:

- To provide dispatchable capacity and other electricity market services which can be used by AEMO to meet the requirements of the NEM
- To supplement Snowy Hydro's generation portfolio with dispatchable capacity when the needs of electricity consumers are highest.

The key economic objective of the Proposal is:

- To provide a fast start firming electricity generation facility to supplement Snowy Hydro's generation portfolio with dispatchable capacity when the needs of electricity consumers are highest.

The key environmental objective of the Proposal is:

- To provide firming capacity to the NEM to support future renewable generation projects.

1.6 Purpose and structure of this EIS

This environmental impact statement (EIS) has been prepared to assess the potential impacts that may arise from the design, construction and operation of the Proposal in accordance with the Planning Secretary's Environmental Assessment Requirements (SEARs) under Section 5.16 of the *Environmental Planning and Assessment Act 1979*. The EIS has also been prepared in accordance with the form and content requirements specified in Schedule 2 of the Environmental Planning and Assessment Regulation 2000. The EIS considers the statutory context of the Proposal, and recommends management measures to avoid, mitigate or manage any identified impacts.

The EIS is comprised of the following chapters as shown in Table 1.1.

Table 1.1: Structure of the EIS

Chapter number	Chapter title	Coverage
-	Executive summary	A stand-alone chapter summarising the Proposal and the key findings of the EIS.
1	Introduction	Provides an overview of the Proposal, details the proponent, and outlines the purpose and structure of the EIS. It lists the SEARs, and references to where in the EIS each requirement is addressed.
2	Proposal description	A detailed description of the Proposal and the main design features and technology selected. This chapter also goes into further detail on the site selection and layout.
3	Statutory context	Describes the applicable environmental legislation and policy, and defines the statutory pathway through which approval for the Proposal is sought.
4	Strategic context and project need	Outlines the strategic context of the Proposal and the key drivers of project need.
5	Stakeholder consultation	Describes the consultation conducted during development of the EIS.
6	Environmental impacts	Introduces the key chapters of the EIS that summarise and present the findings of all technical impact assessment studies carried out for the Proposal.

Chapter number	Chapter title	Coverage
7 – 20	Impact Assessment	Assessment of environmental impacts associated with the Proposal across all aspects of the environment and provides management measures to avoid or minimise these impacts. These chapters include: ▪ Biodiversity ▪ Aboriginal cultural heritage ▪ Non-Aboriginal cultural heritage ▪ Hazards and risks including aviation ▪ Soils and contamination ▪ Groundwater ▪ Surface water and aquatic ecology ▪ Flooding and hydrology ▪ Air quality and greenhouse gases ▪ Noise and vibration ▪ Traffic and access ▪ Landscape character and visual impacts ▪ Socio-economic impacts ▪ Waste management.
21	Cumulative Impacts	An assessment of the likely interactions between the Proposal and any other existing, approved or proposed major projects in the vicinity of the Proposal Site.
22	Summary of mitigation measures	A summary of the control measures recommended in the impact assessment and analyses.
23	Evaluation of costs and benefits	A review of the Proposal against the principles of Ecologically Sustainable Development and objects of the *Environmental Planning and Assessment Act 1979*.
-	References	References of all documentation and online resources used in the preparation of the EIS.
-	Appendices	Appendices used to inform the EIS including technical studies of related environmental disciplines.

1.6.1 Secretary's Environmental Assessment Requirements

The EIS has been prepared to address all of the specific matters identified in the SEARs, which are attached in Appendix A. A summary of where each of the SEARs is addressed in the EIS is provided in Table 1.2.

Table 1.2: SEARs and where they are addressed in EIS

Subject	Requirement	Details	Where addressed in EIS
General requirements	The Environmental Impact Statement (EIS) must comply with the requirements in Schedule 2 of the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation). In particular, the EIS must include, but not necessarily be limited to, the following:	▪ A stand-alone executive summary	Executive summary
		▪ A full description of the project, including: - all components, materials and activities required to construct the project - site plans and maps at an adequate scale showing: the location and dimensions of all project components; and existing infrastructure, land use, and environmental features in the vicinity of the project (including any other existing, approved or proposed infrastructure in the region); - likely staging or sequencing of the project, including construction and rehabilitation	Chapter 2 – Proposal description
		▪ The likely interactions between the project and any other existing, approved or proposed major projects in the vicinity of the site (including the Hydro Kurri Kurri Aluminium Smelter Remediation and Kurri Kurri gas lateral pipeline projects)	Chapter 2 – Proposal description; Chapter 21 – Cumulative impacts
		▪ A general description of any infrastructure that would be required for the project that is the subject of a separate approval process, including the gas lateral pipeline required to connect the project to the gas transmission system	Chapter 2 – Proposal description
		▪ A justification for the proposed project as opposed to other alternatives	Chapter 4 – Strategic context and project need; Chapter 23 – Evaluation of costs and benefits
		▪ Statutory context for the project, including: - how the project meets the provisions and objectives of the Environmental Planning and Assessment Act 1979 (EP&A Act) and EP&A Regulation - consideration of the project against all relevant environmental planning instruments - any approvals that must be obtained before the project can commence	Chapter 3 - Statutory context; Chapter 23 - Evaluation of costs and benefits

Subject	Requirement	Details	Where addressed in EIS
		▪ An assessment of the likely impacts of the project on the environment, focusing on the specific issues identified below, including: - a description of the existing environment likely to be affected by the project using sufficient baseline data	Chapters 6-20 (see below)
		▪ A description of how the project has been designed to avoid and minimise impacts	Chapter 2 – Proposal description; Chapters 6-20
		▪ An assessment of the potential impacts of the project, including any cumulative impacts, and taking into consideration relevant guidelines, policies, plans and industry codes of practice	Chapters 6-20; Chapter 21 – Cumulative impacts
		▪ A consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS	Chapter 22 – Summary of mitigation measures
		▪ An evaluation of the project as a whole having regard to: - relevant matters for consideration under the EP&A Act including ecologically sustainable development	Chapter 23 – Evaluation of costs and benefits
		- the strategic need and justification for the project having regard to energy security and reliability in NSW and the broader National Electricity Market including an analysis of gas supply availability	Chapter 4 Strategic context and project need
		- the biophysical, economic and social costs and benefits of the project.	Chapter 23 – Evaluation of costs and benefits

Subject	Requirement	Details	Where addressed in EIS
Key issues	The level of assessment of likely impacts should be commensurate with the significance or degree or extent of impact within the context of the proposed location and surrounding environment, and having regard to applicable NSW Government policies and guidelines. In particular, the EIS must address the following matters:	▪ **Biodiversity –** including: - an assessment of the biodiversity values and the likely biodiversity impacts of the project in accordance with the NSW Biodiversity Conservation Act 2016, the Biodiversity Assessment Method (BAM 2020) and documented in a Biodiversity Development Assessment Report (BDAR); and - the BDAR must document the application of the avoid, minimise and offset framework including assessing all direct, indirect and prescribed impacts in accordance with the BAM	Chapter 7 – Biodiversity
		▪ **Heritage –** including: - an assessment of the likely Aboriginal impacts of the project in accordance with the Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010), including adequate consultation with Aboriginal stakeholders having regard to the Aboriginal Cultural Heritage Consultation Requirements for Proponents (OEH, 2010)	Chapter 8 – Aboriginal heritage
		- an assessment of likely non-Aboriginal heritage impacts of the project.	Chapter 9 – Non-Aboriginal heritage

Subject	Requirement	Details	Where addressed in EIS
		▪ Hazards and Risks – including: - a Preliminary Hazard Analysis (PHA), covering all aspects of the project which may impose public risks, to be prepared consistent with Hazardous Industry Planning Advisory Paper No. 6 – Guidelines of Hazard Analysis (DPE, 2011) and Multi-level Risk Assessment. The PHA must demonstrate that the risks from the project comply with the criteria set out in Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning (DPE, 2011) - an assessment of bushfire risk in accordance with Planning for Bush Fire Protection 2019 (NSW RFS, 2019) - a plume rise impact assessment prepared in accordance with CASA's guidelines for conducting plume rise assessments, and an assessment of the potential impact to aviation in the vicinity of the project.	Chapter 10 – Hazard and Risk
		▪ Land and Contamination – including: - an assessment of the extent and nature of any contaminated materials or acid sulphate soils on site, having regard to the Hydro Kurri Kurri Aluminium Smelter Remediation project and any other contamination assessments relevant to the site - an assessment of potential risks to human health and the receiving environment associated with potential contamination generated by the operation of the project - a description of the measures that would be implemented to avoid or mitigate impacts.	Chapter 11 – Soils and contaminatio n
		▪ **Water** – including: - an assessment of the impacts of the project on groundwater aquifers and groundwater dependent ecosystems having regard to the NSW Aquifer Interference Policy and relevant Water Sharing Plans	Chapter 12 – Groundwater
		- an assessment of the impacts of the project on water quality having regard to the NSW Water Quality and River Flow Objectives (DECCW, 2006), Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) and ANZECC Guidelines and Water Quality Objectives in NSW (DEC, 2006)	Chapter 13 – Surface water quality and aquatic ecology

Subject	Requirement	Details	Where addressed in EIS
		- a detailed site water balance for the project, including water supply and wastewater disposal arrangements	Chapter 14 – Hydrology and flooding
		- an assessment of flooding and the hydrological impacts of the project	Chapter 14 – Hydrology and flooding
		- a description of the erosion and sediment control measures that would be implemented to mitigate any impacts during construction.	Chapter 13 – Surface water quality and aquatic ecology
		▪ **Air Quality –** including: - an assessment of the likely air quality impacts of the project in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (EPA, 2016), including an assessment of scenarios where the project operates on diesel fuel - ability to comply with the relevant regulatory framework, specifically the Protection of the Environment Operations Act 1997 and the Protection of the Environment Operations (Clean Air) Regulation 2010 - an assessment of the likely greenhouse gas impacts of the project.	Chapter 15 – Air quality and greenhouse gas
		▪ **Noise and Vibration –** including: - assessment of the likely construction noise impacts of the project under the Interim Construction Noise Guideline (DECCW, 2009) - an assessment of the likely operational noise impacts of the project under the NSW Noise Policy for Industry (EPA, 2017) - an assessment of the likely road noise impacts of the project under the NSW Road Noise Policy (EPA, 2011) - an assessment of the likely vibration amenity and structural impacts of the project under Assessing Vibration: A Technical Guideline (DEC, 2006) and German Standard DIN 4150-3 Structural Vibration – effects of vibration on structures.	Chapter 16 – Noise and vibration

Subject	Requirement	Details	Where addressed in EIS
		▪ **Transport** – including: - an assessment of the transport impacts of the project on the capacity, condition, safety and efficiency of the local and State road network - an assessment of the likely transport impacts to the site access route and site access point having regard to Oversized or Over mass vehicles (if required) - a description of the measures that would be implemented to mitigate any impacts during construction - a description of any proposed road upgrades developed in consultation with the relevant road authorities (if required).	Chapter 17 – Traffic and access
		Visual – including an assessment of the likely visual and landscape character impacts of the project on the amenity of the surrounding area and private residences in the vicinity of the project.	Chapter 18 – Landscape character and visual impact assessment
		Socio-Economic – including an assessment of the likely impacts on the local community, demands on Council infrastructure and consideration of construction workforce accommodation.	Chapter 19 – Socio-economic impact assessment
		Waste – identify, quantify and classify the likely waste stream to be generated during construction and operation, and describe the measures to be implemented to manage, reuse, recycle and safely dispose of this waste.	Chapter 20 – Waste
Consultation	During the preparation of the EIS, you must consult with the relevant local, State and Commonwealth Government authorities, infrastructure and service providers, community groups and affected landowners. The EIS must describe the consultation that was carried out, identify the issues raised during this consultation, and explain how these have been considered and addressed.		Chapter 5 – Stakeholder consultation

Subject	Requirement	Details	Where addressed in EIS
Further consultation after 2 years	If EIS for the project is not lodged within 2 years of the issue date of these Environmental Assessment Requirements, the Applicant must consult further with the Secretary in relation to the preparation of the EIS.	Not applicable – EIS lodged within 2 years of SEARs issues date.	-

1.6.2 Environmental Planning and Assessment Regulation 2000

Schedule 2 of the EP&A Regulation (Schedule 2, clauses 6 and 7) stipulates the general form and content requirements for an EIS. Table 1.3 identifies how this EIS addresses these form and content requirements.

Table 1.3: EP&A Regulation: EIS form and content requirements

Requirement	Where addressed in this EIS
An environmental impact statement must contain the following information:	
(a) the name, address and professional qualifications of the person by whom the statement is prepared	EIS Certification Page (Statement of validity)
(b) the name and address of the responsible person	EIS Certification Page (Statement of validity)
(c) the address of the land:	73 Dickson Road, Loxford NSW 2326
i. In respect of which the development application is to be made, or	EIS Certification Page (Statement of validity)
ii. On which the activity or infrastructure to which the statement relates is to be carried out	EIS Certification Page (Statement of validity)
(d) a description of the development, activity or infrastructure to which the statement relates	EIS Chapter 2
An environmental impact statement must also include each of the following:	
(a) a summary of the environmental impact statement	Executive summary
(b) a statement of the objectives of the development, activity or infrastructure	Section 1.5
(c) an analysis of any feasible alternatives to the carrying out of the development, activity or infrastructure, having regard to its objectives, including the consequences of not carrying out the development, activity or infrastructure	Chapter 4

Requirement		Where addressed in this EIS
(d) an analysis of the development, activity or infrastructure, including:		
(i)	A full description of the development, activity or infrastructure	Chapter 2
(ii)	a general description of the environment likely to be affected by the development, activity or infrastructure, together with a detailed description of those aspects of the environment that are likely to be significantly affected	Section 1.4 and Section 4.4.4; 'Existing Environment' sections of Chapters 7-20
(iii)	the likely impact on the environment of the development, activity or infrastructure	Chapters 7-21
(iv)	a full description of the measures proposed to mitigate any adverse effects of the development, activity or infrastructure on the environment and	Chapter 22
(v)	a list of any approvals that must be obtained under any other Act or law before the development, activity or infrastructure may lawfully be carried out	Section 3.7
(e) a compilation (in a single section of the environmental impact statement) of the measures referred to in item (d) (iv)		Chapter 22
(f) the reasons justifying the carrying out of the development, activity or infrastructure in the manner proposed, having regard to biophysical, economic and social considerations, including the principles of ecologically sustainable development set out in subclause (4)		Chapter 4, Chapter 23

2. Proposal description

2.1 Proposal summary

Snowy Hydro is seeking to develop a new gas fired power station in the Hunter Valley to increase its dispatchable generating capacity in NSW. The Proposal would be able to supply electricity to the grid at short notice during periods of high electricity demand including during low supply periods from intermittent renewable sources or during supply outages at other base load power stations.

The power station would be a dual fuel (gas and diesel), "peak load" generation facility supplying electricity at a capacity of up to approximately 750 MW which would be generated via two heavy-duty OCGT's.

The Proposal involves the construction and operation of a power station together with other associated infrastructure. The major supporting infrastructure required for the Proposal would be a 132 kV electrical switchyard located adjacent to the power station but within the Proposal Site. A new gas lateral pipeline (which would be developed by a third party, and subject to a separate planning approval) would also be required to supply gas to the power station, but is not part of this Proposal. The Proposal would connect into existing 132 kV electricity transmission infrastructure located near the Proposal Site.

The Proposal has a capital cost of approximately $610 million, and the power station is anticipated to be fully operational by the end of calendar year 2023. An overview of the Proposal, listing details of the development for which approval is sought, is summarised in Table 2.1 and shown in Figure 2.1.

Table 2.1: Key Proposal elements

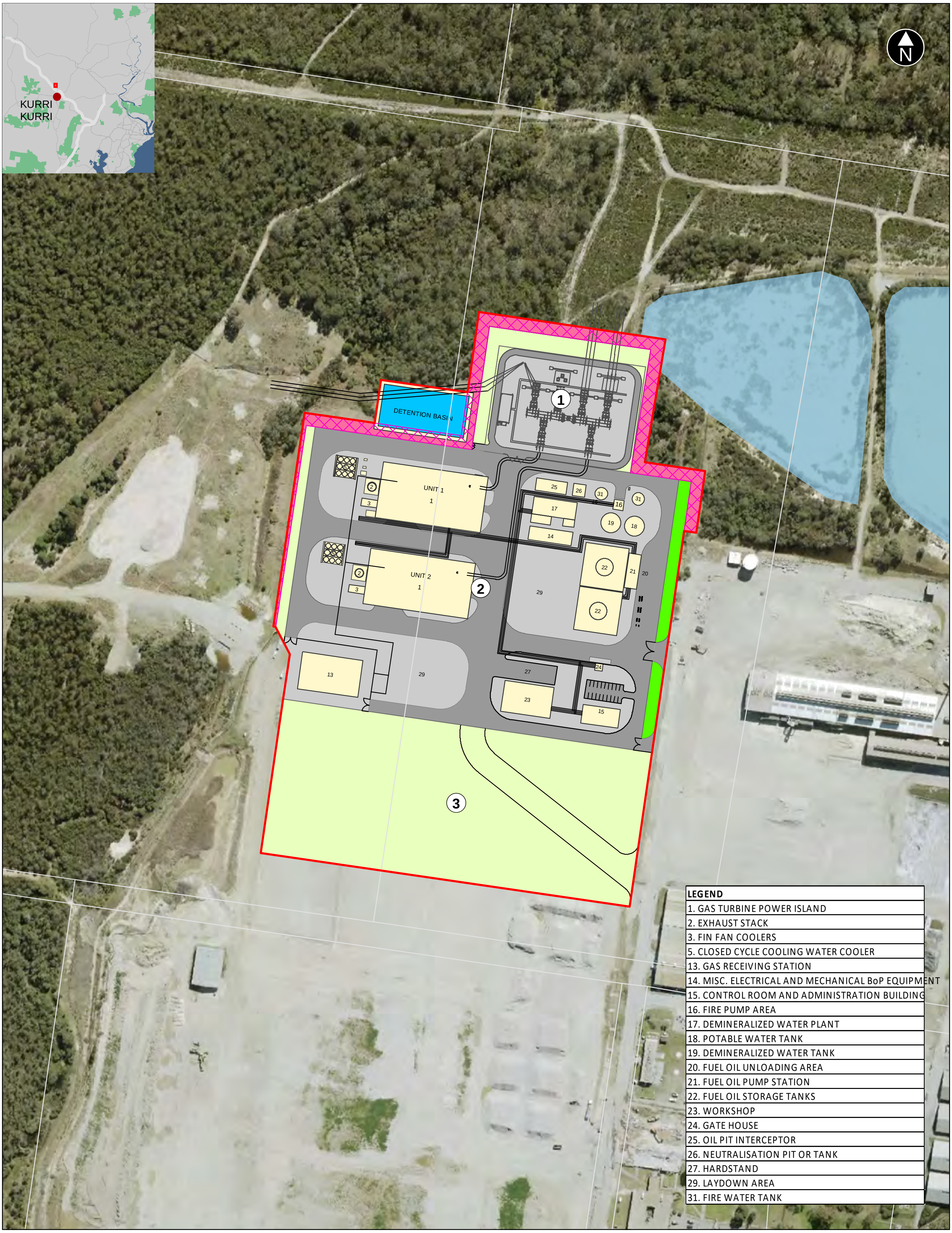
Proposal element	Summary
Proposal address	73 Dickson Road, Loxford NSW 2326.
Proposal area	The Proposal Site comprises approximately 12.75 ha, and is shown overlaid on existing cadastral boundaries in Figure 1.2. The land is currently described as: ▪ Part Lot 319 DP 755231 ▪ Part Lot 769 DP 755231. The Proposal Site is subject to a boundary adjustment application (see discussion in section 4.4.4). The property description (Lot/DP) is therefore subject to change prior to the development commencing.
Development footprint	Proposed development area occupies land having a total area of 12.75 ha. Each component of the proposal occupies part of the two Lots/DPs described above, as follows: ▪ Power Island area 6.81 ha ▪ Switchyard area 1.29 ha ▪ Buffer area 3.73 ha ▪ Asset Protection Zone (APZ) 0.61 ha ▪ Stormwater basin (subject to detailed design) 0.3 ha.
Gas Turbine Power Island	Two heavy duty F-class OCGTs, with the necessary balance of plant infrastructure, generator circuit breakers and generator step-up transformers.

Proposal element	Summary
132 kV Electrical switchyard	Circuit breakers, bus-bars, isolators, series reactor and switchyard equipment including either underground cables or overhead line support gantries between the power station and the switchyard. Switchyard would be either air-insulated or gas-insulated; subject to detailed design. Switchyard voltage would be 132 kV. The switchyard would connect directly to existing Ausgrid overhead 132 kV transmission lines.
Zoning	The Proposal Site is currently zoned RU2 Rural Landscape under the Cessnock Local Environmental Plan 2011 (Cessnock LEP). The Proposal Site and surrounds are subject to a rezoning proposal. The Proposal Site is expected to be rezoned as IN3 Heavy Industrial if the rezoning proposal is approved.
Supporting balance of plant infrastructure of the Proposal	▪ Internal site access roadways ▪ Water storage tanks (potable, fire and demineralised), pumps, demineralised water plant, piping ▪ 2 x Diesel fuel storage tanks, effective volume of approximately 1.75 ML each, and forwarding pumps ▪ Diesel tanker truck unloading facilities ▪ Other (non-fuel) truck loading/unloading facilities ▪ Control room ▪ Concrete bunded areas with drains for liquid fuel tanks, liquid chemicals store, oil filled transformers and other facilities where such liquids could leak ▪ On site oily water separation system, with pit or tank storage, including facilities for: - Diesel fuel unloading area - Diesel fuel storage tanks bund - Gas turbine diesel fuel skid - Gas turbine and generator lube oil area - Gas turbine wash drains - Generator step up transformer bund. ▪ Concrete foundations, bitumen roadways, concrete surfaces in liquid fuel unloading station and gas turbine unit maintenance areas ▪ Stormwater drainage system e.g. pits, pipes, triple interceptor or equivalent, pumps (as required) ▪ Security fence, security lighting, stack aviation warning lights (if required) and surveillance system ▪ Office/administration buildings and amenities ▪ Workshop, warehouse/storage areas ▪ Communication systems ▪ Occupational health and safety systems including an emergency warning and evacuation system ▪ Firefighting system including water storage, pumps, hydrants and deluge systems (as required) ▪ Emergency diesel generator(s) with associated internal fuel storage ▪ Closed circuit cooling systems for small on-site heat exchangers ▪ Local electrical switch/control rooms ▪ Laydown areas ▪ Landscaped areas and staff parking ▪ Other ancillary facilities located within the Proposal Site (see Figure 2.1).

Proposal element	Summary
Existing supporting infrastructure (off site)	▪ Public road network including Hart Road and M15 Hunter Expressway ▪ Waste and wastewater disposal facilities in the region ▪ Auxiliary power supply network.
Proposed water management	Potable water and wastewater/ trade waste would be connected to existing Hunter Water infrastructure. Supply to the Proposal Site boundary would be by others. Water storage: ▪ 2 x fire water tanks, effective volume approximately 0.5 ML (total 1.0 ML) ▪ 1 x potable water tank, effective volume approximately 1.6 ML ▪ 1 x demineralised water tank, effective volume approximately 1.6 ML ▪ Sewage system for the Proposal would connect to the Hunter Water sewer network ▪ Stormwater drainage system for collection and discharge of rainwater will be discharged to the environment via a stormwater basin (see Figure 2.1) ▪ Trade waste water treatment and discharge to the Hunter Water sewer network ▪ Sumps or tanks for collection of waste effluent prior to offsite disposal.
Proposed commencement of operation	Approximately August to December 2023.
Anticipated life of the Proposal	Approximately 30 years.
Design life of mechanical and electrical plant	30 years.
Design life of civil and structural plant	50 years.
Construction duration	Approximately two years.
Construction hours	It is anticipated that works would be undertaken mostly during standard construction hours (7:00 am to 6:00 pm weekdays and 8:00 am to 1:00 pm on Saturdays). Out-of-hours construction activities would be conducted as required, e.g. delivery of large items of plant requiring oversize vehicles.
Construction workforce	Expected peak construction workforce of approximately 250 full time equivalents.
Operational workforce	Permanent site staff numbers are not expected to exceed an average of 10 full time equivalent persons (FTE). A small number of additional support staff and deliveries of consumables, waste disposal, sanitary services, and specialist maintenance staff may also be required on a weekly basis. Potential contractor workforce of up to 50 persons during infrequent maintenance events, outages etc.

Proposal element	Summary
Capacity factor	The Proposal is seeking approval for a capacity factor[1] of up to 10 per cent on natural gas and up to two per cent on diesel (providing a combined capacity factor of 12 per cent) in any given year. However, it is expected that likely operations would result in a capacity factor of two per cent in any given year. The EIS assessments are based on the Proposal operating 12 per cent of the year at 100 per cent plant load.
Capital cost	Approximately $610 million

[1] The capacity factor is the proportion of actual energy generated per year (expressed as MWh) compared with the total energy that could have been produced if operating at full load for every hour of the year (expressed as MWh).



Proposal Site
Asset protection zone
Detention basin
Sealed roadway
Crushed rock
Landscaping
Grass / Road base
Existing waterbodies
Existing cadastre
1 Proposed Switchyard Area
2 Proposed Plant Area
3 Proposed Buffer Area

0 100 200 m

1:4,000 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 2-1 Proposal Site Layout

2.2 Proposed design

The Proposal would comprise two heavy-duty F Class gas turbines. The Proposal would have a nominal total electrical output of up to approximately 750 MW, but this would be dependent on the ultimate gas turbine selected from available manufacturers. The eventual choice of gas turbine would be based on a range of environmental, engineering and economic factors that would be considered as the Proposal's design advances.

The gas turbines are expected to operate on natural gas fuel as the primary fuel source. However, the turbines would be capable of operating on diesel as necessary and this functionality would be incorporated into the Proposal. Operation on diesel fuel is considered a 'back-up' function in the event that gas supply to the Proposal Site is not available for any reason.

There is the potential that the natural gas lateral and consequently gas supply may not be constructed in time for commissioning and operation of the gas turbines units. This period might be for approximately six months and would depend on the gas pipeline construction timeframe (to be done by a third party). It is noted that operation on diesel during the commissioning phase and initial post-commissioning phase would be as a peaking power station in line with the Proposal objectives, with the overall hours of operation expected to be low, in the order of approximately 2 per cent of available operating hours in that six month period. Following this initial period, the power station would operate as dual fuel once the gas supply to the Proposal Site has been established.

The main design elements of the Proposal are as listed in Table 2.2 and illustrated in Figure 2.1.

The power station would be monitored and controlled from Snowy Hydro's Control Centre in Cooma, NSW, with local control of the power station also able to be taken as required. Local staff would be in attendance during business hours and respond to call-outs as required.

The main elements of the Proposal are discussed in detail in Section 2.2.1 to Section 2.2.10.

2.2.1 Open cycle gas turbine

Electricity would be generated by gas turbines through the combustion of natural gas or diesel fuel within the turbines.

The gas turbine units consist of a compressor, dry low NO_x burners (for natural gas operation; see Section 2.2.4) and combustion chamber, turbine and electricity generator. Air is compressed to a high pressure before being admitted into the combustion chamber. Fuel (natural gas or diesel with water injection as required) is injected into the combustion chamber where combustion occurs at high temperatures and the gases expand. The resulting mixture of pressurised hot gas is admitted into the turbine causing the turbine and its rotor to turn the generator thus generating electrical power. In an open cycle configuration, hot exhaust gas is vented directly to the atmosphere through an exhaust stack (the gas temperature could be in the order of 600°C). This contrasts with a combined cycle configuration which uses gas and steam together to generate energy, and routes waste heat back into a steam turbine. The gas turbine plant layout would not make provision for future conversion to a combined cycle gas turbine.

The open cycle configuration enables peaking operation, fast start and firming generation coverage for intermittent renewable generation.

As is now required under current NSW energy policy (see Section 4.3.3), most of the potential gas turbine equipment suppliers for the Proposal are continuing to investigate the use of hydrogen as a fuel and have tested operation with a blend of up to approximately 20-30 per cent hydrogen in gaseous fuels on some of their large industrial frame machines (similar to this Proposal). There is the potential for the Proposal's gas turbines to be fired on a certain percentage of hydrogen in the future when the technology and infrastructure becomes more economic. However, this would require some modification to the power station and gas turbines.

A simple schematic representation of the operation of an OCGT is shown in Figure 2.2.

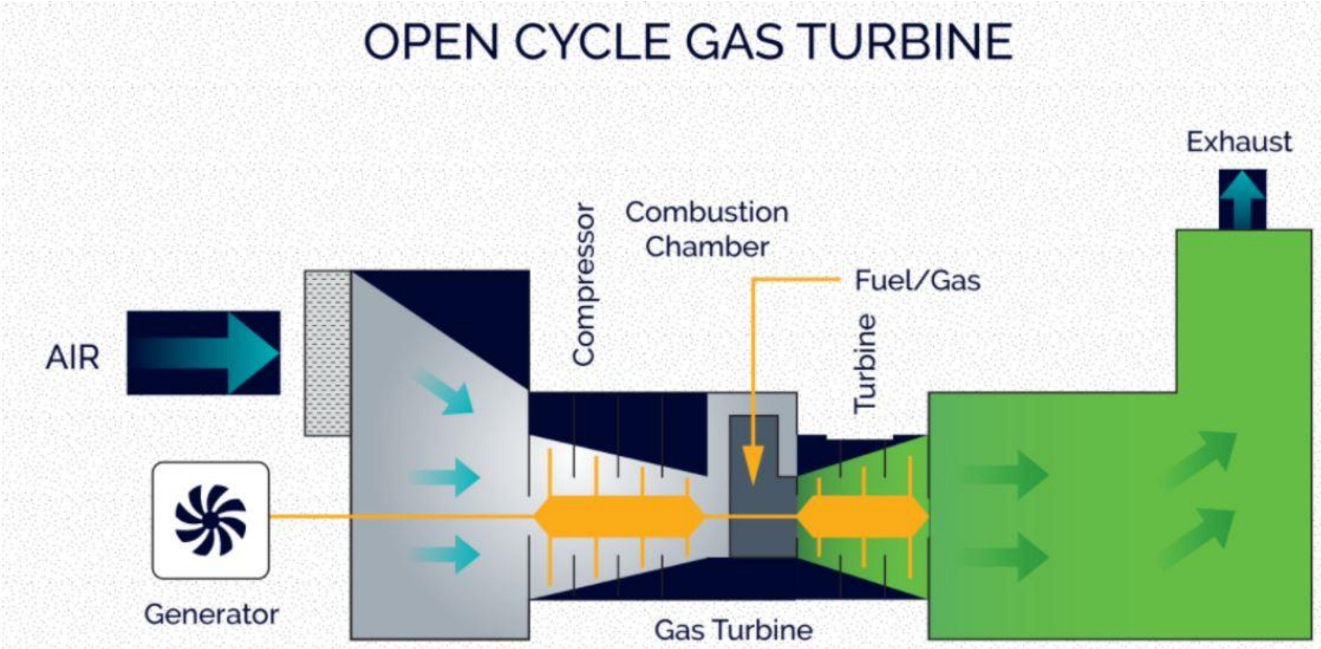


Figure 2.2: Open Cycle Gas Turbine – Schematic diagram

There are multiple different gas fired turbine and engine product options available for the Proposal. The main factors considered in the identification and selection of a suitable option for use in the Proposal included:

- Performance characteristics (efficiency, output)
- Operational characteristics (start-up times and operational requirements, usage rates of consumables)
- Integration with existing infrastructure
- Compliance with enabling legislation, codes and standards
- Capital, operating and maintenance costs.

At the conclusion of this identification and selection process, the industrial frame heavy duty F-Class gas turbine was nominated and selected as being the most suitable for the Proposal. F-class gas turbines are open cycle units with a firing temperature of approximately 1500°C and generating output of up to approximately 375 MW each at nominal ISO conditions (15°C and 60 per cent relative humidity).

The gas turbines are proposed to be configured with at least the following equipment:

- Turbine and generator
- Dual-fuel combustors capable of firing natural gas fuel (with dry low NO_X burners) or diesel fuel
  - Operation on diesel fuel would require demineralised water injection for nitrogen oxide (NO_X) emission control.
- Air intake filterhouse and ducts
- Evaporative inlet air cooling and fogging/wet compression systems (introducing inlet air with fine water droplets) on the turbines to maximise output during hot weather
- Exhaust stack
- Natural gas and diesel fuel package skids
- Fin fan coolers for lube oil and generator systems
- Power control centre including all electronic control cabinets and battery rooms/compartments

- Lube oil and water injection modules
- All instrumentation, control, monitoring and protection equipment for the turbines.

2.2.2 Gas Fuel System

The Proposal would be primarily fuelled by natural gas. A gas receiving station would be established inside the Proposal Site boundary, but is the subject of planning, design, approval, construction and operation by others, and is not included as part of this Proposal. The terminating point for this Proposal is the outlet flange of the gas receiving station. The gas receiving station would comprise facilities for gas metering, pressure regulation, heating stations (water bath heaters or equivalent), distribution manifold, piping and valves and potential provision for flaring.

The gas fuel system would be designed to provide gas at a pressure and temperature as required by the gas turbines.

2.2.3 Diesel Fuel System

The Proposal would also be capable of being operated on diesel fuel. Two diesel fuel storage tanks of approximately 1.75 ML volume (subject to detailed design and eventual gas turbine selected) are expected to be required to store sufficient fuel to enable the Proposal to operate at maximum capacity for nominally three consecutive days (10 hours of operation each day). The tanks would be located in a bund with net capacity of 110 per cent of the largest tank capacity in accordance with Australian Standards.

Permanent on-site pumps would be required with sufficient capacity to unload a B-double tanker (approximately 50 kL per tanker) and transfer diesel fuel into the storage tanks. These pumps would also allow for pumping from tank to truck if required. In addition, diesel fuel forwarding pumps would be installed to draw diesel from the storage tanks and forward it to the gas turbine diesel fuel skids, through a low-pressure filter and flow control valve.

The unloading and forwarding pumps would be located in a bunded facility.

The tank unloading area would be within a drive-in bund sized to handle the loss of containment from two B-double trailer tank compartments.

2.2.4 Fuel sulphur content

Estimates for the sulphur contents of the natural gas and diesel fuels to be used by the Proposal were assumed for the purposes of calculating exhaust emissions of sulphur dioxide (SO_2). As a conservative step in the assessment, the natural gas sulphur content adopted was 50 mg/m^3, which is the maximum total sulphur allowed in natural gas as specified in Australian Standard *AS 4564:2011 – Specification for general purpose natural gas* and also as referenced by the Australian Energy Market Operator (AEMO) in their Gas Quality Guidelines. The actual sulphur content in natural gas used by the Proposal is expected to be significantly less than this.

The sulphur limit for diesel fuel used by the Proposal will be below 10 mg/kg, which is the maximum allowed for Automotive Diesel.

The *Protection of the Environment Operations (Clean Air) Regulation 2010* sulphur limit is much higher – 25 g/kg, for an in-stack emission limit applicable for outside the Newcastle Metropolitan Area. However, such a high sulphur-content fuel is unlikely to be delivered to Australia in the future.

2.2.5 Emission controls

The primary emission of concern from gas turbine operation is the generation of oxides of nitrogen. Consequently, emissions control technology is required to bring the levels of oxides of nitrogen to within acceptable standards and regulatory limits. Pollutants such as particulate matter and oxides of sulphur are controlled through fuel quality and not as part of the gas turbine technology. Other airborne by-products and pollutants occurring from the combustion of natural gas and diesel in gas turbines are:

- Nitrogen (N_2)
- Oxygen (O_2)
- Carbon dioxide (CO_2)
- Water vapour (H_2O)
- Carbon monoxide (CO)
- Unburned hydrocarbons (UHC); usually expressed as equivalent methane (CH_4) particles
- Oxides of sulphur (SO_2 and SO_3)
- Particulates.

A detailed discussion of the Proposal's potential air quality impacts, and the measures proposed to mitigate any potential impacts, is contained in Chapter 15.

Oxides of nitrogen are a potential pollutant of concern that can be managed through the design of the gas turbines. There are two sources of NO_x emissions in a gas turbine's exhaust. Most of the NO_x is generated by the fixation of atmospheric nitrogen in the flame, and is known as thermal NO_x. Other NO_x are generated by the conversion of a fraction of any nitrogen chemically bound in the fuel, and are known as fuel-bound nitrogen (or FBN). The amount of thermal NO_x produced depends on the combustion temperature; the lower the combustion temperature, the lower the NO_x emissions.

Dry Low Emission (DLE) technology reduces the concentration of NO_x emissions from gas fired turbines. DLE technology overcomes the need for water and/or steam cooling or injection. A DLE combustor operates on the principle of lean premixed combustion. The lean fuel and air mixture results in a lower firing temperature during combustion and consequently less generation of thermal NO_x. Consequently gas turbines with DLE technology, as proposed in this Proposal, can achieve very low NO_x emissions, and this is the current best practice in the gas turbine industry.

DLE technology is applicable only when a turbine is operating on gas fuel. As a dual-fuel power station, the Proposal would be also capable of being operated on diesel fuel in the case that gas fuel is unavailable. Diesel fuel burns at a higher temperature than the gas fuel, and hence thermal NO_x is produced at a higher rate compared with gas fuel. Water injection is commonly used to assist in control of NO_x emissions to within the prescribed limits when operating on diesel. Demineralised water is injected into the combustion chamber, which has the effect of reducing the combustion temperature and hence the formation of thermal NO_x. This is considered best practice in the gas turbine industry when operating a gas turbine on diesel fuel.

2.2.6 Generating equipment

The Proposal seeks to utilise heavy-duty F-Class OCGTs. An evaluation and tender process will be undertaken to select the preferred gas turbine manufacturer. This evaluation process would consider several factors, some of which include:

- Performance characteristics such as thermal efficiency, heat rate and output at different ambient conditions and loading, firing gas or diesel
- Operational characteristics such as start-up times and operational flexibility, usage rates of consumables such as water and oil and catalysts and auxiliary power consumption when off-line and in service

- Environmental factors such as air emissions, noise and water use
- Compliance with the applicable legislation, codes and standards
- Capital, operating and maintenance costs.

2.2.7 Ancillary facilities

Ancillary facilities required to support the Proposal are listed in Table 2.2.

These facilities are required for the construction and operation of the Proposal. The majority of these facilities would be shared between the two gas turbines. Where possible the facilities would be sized to service both gas turbines.

2.2.8 Gas pipelines

Natural gas to be used by the Proposal would be supplied from the existing eastern Australia gas transmission network and the many other facilities that feed into it. The Proposal would require connection to a new gas transmission and storage pipeline, which would connect into the existing Sydney to Newcastle Jemena Gas Networks (JGN) gas transmission pipeline, with the tie in point to be located within the proximity of the Newcastle area. The new gas transmission and storage pipeline, and the gas receiving station, would be designed, constructed, operated and maintained by a third party, and would be the subject of a separate application for approval. However, the Minister's declaration of the Proposal as Critical State Significant Infrastructure (CSSI) (see Chapter 3) includes the gas lateral pipeline and gas receiving station.

The pipeline would terminate at the gas receiving station inside the boundary of the Proposal Site. Gas conditioning, pressure let-down and other processes necessary to prepare gas for turbine combustion are performed by the gas receiving station. While it would be positioned within the Proposal Site boundary, the gas receiving station, along with the gas pipeline, are not part of this Proposal.

2.2.9 Electrical switchyard

The proposed location of the new 132 kV electrical switchyard is shown in Figure 2.1. The final configuration of the switchyard would be confirmed during the detailed design process.

The new electrical switchyard would transfer the electricity produced at the power station to the regional electricity transmission and distribution system within the NEM.

2.2.10 Water and wastewater

The Proposal would connect to an existing Hunter Water potable water supply pipeline. Water storage tanks would be provided within the Proposal boundary to assist with the peak water demands. Potable water would be used for evaporative cooling of air into the gas turbines and other station water demands such as fire suppression (a rare occurrence), gas turbine compressor washing, and Proposal amenities.

Groundwater is not proposed to be used during the construction or operation of the power station.

A demineralised water plant would be included within the Proposal Site. Demineralised water would be required for wet compression/fogging (cooling of the air to improve the gas turbine performance mainly during high ambient temperature conditions or when additional power augmentation is required) and for water injection when operating the plant on diesel fuel (for NO_x emission control).

Wet compression/fogging would most likely be used only on hot days when the plant is operating on gas fuel. Likewise, evaporative cooling of the inlet air would be used on hot days when operating on gas fuel or diesel fuel, and water injection to control NO_x emissions is required only when firing on diesel. When operating on diesel, once the water is injected into the gas turbine combustion chamber, it would evaporate and be discharged to the atmosphere via the exhaust stack.

The Proposal's wastewater disposal needs (trade waste and municipal sewage) would be met through connection into existing Hunter Water infrastructure with the connection point being within the proximity of the Proposal Site boundary (see Chapter 13). New water and wastewater reticulation infrastructure will be constructed within the Proposal Site.

Trade waste discharge from the Proposal Site would consist mainly of demineralised water plant regeneration wastewater, water discharged from the gas turbine evaporative coolers and discharge from some oily water separators. Trade waste would be discharged after any required on-site treatment and would comply with Hunter Water trade waste requirements. Potential treatment and discharge/disposal options could include:

- Treatment in a neutralising tank or pit before being discharged to the sewer as trade waste under a trade waste agreement
- Collection by a liquid waste truck for offsite disposal.

Stormwater management

As shown in Figure 2.1, a stormwater basin forms part of the Proposal Site drainage system. The stormwater basin serves various functions during construction and operation. During construction the basin would act as a sediment basin to capture and treat runoff prior to discharge to the unnamed tributary of Black Waterholes Creek. During operation the basin would manage stormwater from the site such that:

- Peak discharges from the Proposal are no larger than peak discharges from the site prior to development
- Stormwater pollutant loads from the Proposal are reduced so that they are not higher than that from the site prior to development.

A stormwater basin is the most common way of managing water quality/sediment during construction, and for water quality management and flood peak attenuation during operation. However, other options which would achieve similar outcomes are also being considered and may be adopted by the designer and constructor.

Further details regarding the form, location and sizing of stormwater management measures are provided in Chapter 13 and Chapter 14, and are subject to refinement and confirmation during detailed design.

2.3 Proposal layout and location

The Proposal Site is located in the small suburb of Loxford in the Hunter Valley region of New South Wales, approximately 2.5 km north of the town of Kurri Kurri, approximately 35 km west of Newcastle and 125 km north of Sydney as described in Chapter 1 and shown in Figure 1.1. The Proposal Site is located within the Cessnock City Council LGA.

Snowy Hydro's planned purchase of approximately 11.83 ha of land for the power station and switchyard would largely encompass the land shown in Figure 1.2. In addition, Snowy Hydro intend to acquire the necessary interests in land for the Asset Protection Zone (APZ) and stormwater basin resulting in a total Proposal Site area of approximately 12.75 ha.

Snowy Hydro would take possession of a vacant, predominately cleared and remediated Proposal Site, generally level and rectangular in shape. The Proposal Site would also accommodate a buffer area of approximately 3.73 ha, as shown in Figure 2.1. Around the northern perimeter of the Proposal Site, where it is adjacent to areas of vegetation, a 10 m APZ would provide a firebreak and access for bushfire fighting purposes. As also shown in Figure 2.1, a stormwater basin (subject to detailed design) would be constructed adjacent to the site's northern boundary and to the west of the electrical switchyard.

2.3.1 Access

The Proposal Site is accessed off Hart Road which is adequate for construction and operation of the Proposal. Any improvements to Hart Road would be provided by others and would be sufficient for oversized trucks with heavy loads during the construction and operation of the Proposal.

A route survey for delivery of oversize overmass (OSOM) loads during construction shows that no significant road upgrades will be required for these loads. A permit would be sought from the National Heavy Vehicle Regulator (NHVR) as described in Section 17.3.

During construction and operation, all vehicular access to the Proposal Site, including heavy vehicles would be via the Hunter Expressway and Hart Road.

Parking for staff would be provided on-site.

2.4 Proposal construction

The main elements of the Proposal are outlined in Section 2.1. The Proposal is anticipated to be in operation by the end of calendar year 2023, subject to Snowy Hydro securing all the necessary approvals. The key construction activities for the Proposal, at a high level, would include:

- Installation and maintenance of environmental controls such as temporary runoff and sediment controls
- Clearing of vegetation at the switchyard site
- Earthworks to prepare the Proposal Site and construction areas
- Installation of foundations and underground services
- Construction of internal roads within the Proposal Site
- Installation of above ground civil, mechanical and electrical plant and equipment within the Proposal Site
- Construction of a new electrical switchyard
- Connection to new gas lateral pipeline and gas receiving station (developed by others)
- Commissioning and testing
- Removal of construction equipment and rehabilitation of construction areas.

These activities are described in the following sections. Construction traffic, plant and machinery required to construct the Proposal is summarised in Section 2.4.8 and Table 2.3.

Subject to the Proposal's planning approval, the construction contractor's notice to proceed is anticipated to allow construction and commissioning activities to commence in approximately January of 2022, and commercial operation is planned to commence between August 2023 and December 2023.

2.4.1 Site establishment and earthworks

The initial phase of construction would involve establishment of the construction site including temporary sheds and amenities, fencing, erosion and sediment controls, internal roads and laydown/stockpiling areas and site surveys.

Once the site has been established, earthworks would commence, with the following high level key activities occurring:

- Initial site clearing and grading works. Earthworks may also involve small amounts of cut and fill to achieve the necessary design levels across the Proposal Site
- Trenching for underground utilities and services would be installed such as stormwater, water and sewer reticulation, electrical cables, and (internal) gas pipes between the gas receiving station and the gas turbine locations
- Preparation and construction of foundations for the entire Proposal Site. Deep piling is expected to support the heaviest infrastructure such as the gas turbines, generator and the main step-up transformers while shallower piling or pad type foundations would underpin the foundations of the site where the proposed surface loads are less (e.g. site office, car park, landscaped areas etc.). Final numbers and depth of foundation piles is subject to detailed design, as is the piling method (i.e. bored; driven; vibration piling)
- Reinforced concrete slabs would be constructed in certain pavement areas of the Proposal Site, with other areas being surfaced with crushed rock or other suitable materials.

2.4.2 Internal roadworks and hardstand areas

As shown in Figure 2.1 the finished site would be a combination of sealed with asphalt or concrete hardstand areas, and surfaced with crushed rock where a more pervious surface is warranted. It is expected that some of these works may closely follow the site earthworks and foundation works, and would be implemented prior to commencement of above-ground construction and installation of major plant items (Section 2.4.3) The works would involve construction of reinforced concrete pavement with sufficient strength to support heavy vehicles up to B-double size. Geometrically, the proposed internal road layout would be designed to accommodate the turning paths of large vehicles up to B-double size, cranes and large articulated vehicles required for maintenance purposes, such that all movements in and out of the site can be made generally in a forward direction.

Roadworks and hardstand areas would also be provided for permanent staff parking (light vehicles), delivery/ laydown areas, and where required, bunded areas for delivery, handling and storage of fuel and other hazardous materials.

2.4.3 Civil, electrical and mechanical construction

Once the Proposal Site roads and ground infrastructure are complete, delivery and installation of the major plant items associated with the gas turbines would commence. The size of the construction workforce would likely peak during this phase of construction (including switchyard construction), and the levels of construction activity, including construction traffic, would also peak accordingly. As indicated in Figure 2.3 below, this phase of construction would likely span the period between mid to end 2022 and mid-2023.

The construction of the switchyard may occur in parallel with the other major electrical and mechanical construction works outlined above.

2.4.4 Connection to gas lateral pipeline

The gas lateral pipeline to be constructed (by others) to service the Proposal is expected to terminate in the area adjacent to the south west corner of the Proposal Site boundary at the approximate location of the gas receiving station, as indicated in Figure 2.1. As one of the final stages of construction, a connection into the gas receiving station would be constructed from the gas lateral termination point. Gas supply would not be activated until all plant construction works, testing and certification are complete.

2.4.5 Commissioning and testing

Prior to the commencement of operation, the Proposal would be subject to a comprehensive and rigorous program of testing and certification of all components, systems and processes. The primary objective of the commissioning and testing process would be to demonstrate that the Proposal can operate to required standards of safety, efficiency, commercially required operating characteristics, the National Electricity Market, and environmental performance specified by the design and by industry and regulatory standards. All aspects of the commissioning and testing phase would be certified and documented prior to the Proposal commencing operation.

2.4.6 Landscaping and demobilisation

The final construction element would be the installation and establishment of landscaping and other civil requirements (such as final site grading) in accordance with an approved landscape plan, which would primarily involve planting around the perimeter of the eastern boundary of the Proposal Site. The purpose of the proposed site landscaping would be aesthetic and would be designed so as not to compromise any site safety or operational requirements.

2.4.7 Construction workforce

A preliminary construction workforce requirement aligned with an approximate construction schedule is shown in Figure 2.3. The initial construction phase is expected to consist of site preparation and ground works, and demolition and preparation of the new switchyard. The number of personnel onsite would increase substantially immediately prior to, and in the months following, the delivery of the main turbine-generator equipment. The final commissioning phase is likely to require no more than 50 persons onsite.

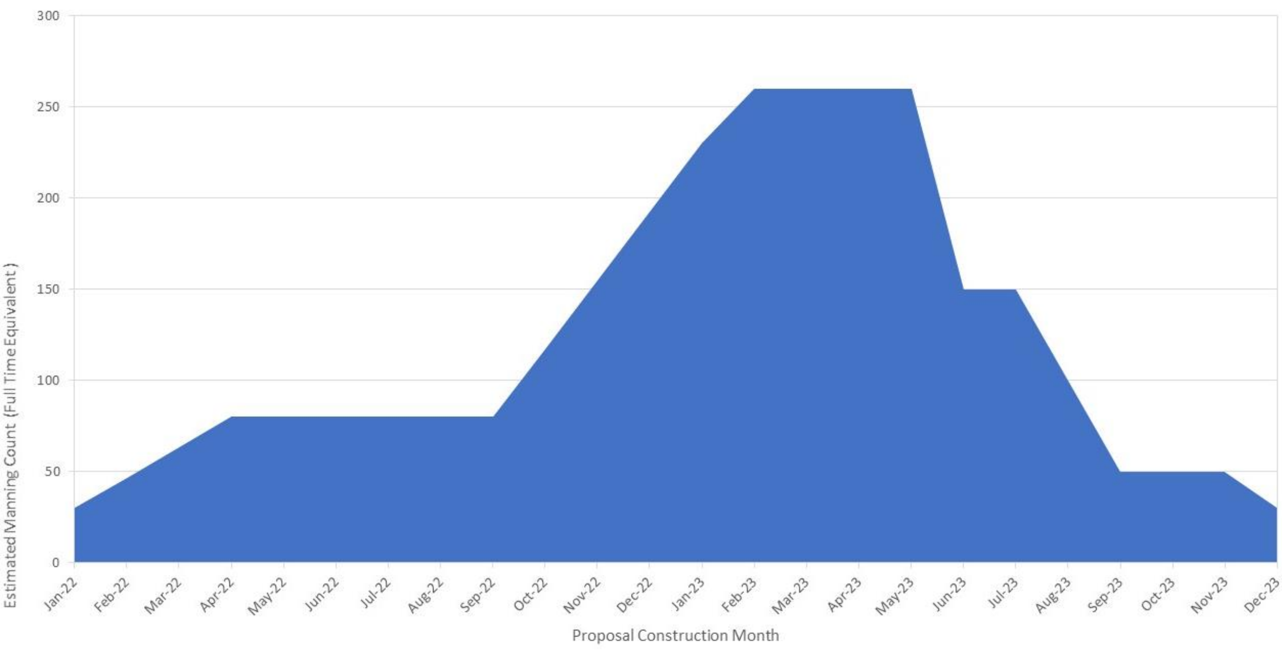


Figure 2.3: Construction workforce estimate

2.4.8 Construction traffic, plant and machinery

An increase in local traffic would accompany construction activities. The bulk of additional traffic would consist of passenger vehicles operated between the construction site and accommodations; these would include cars, utilities, and light buses. Due to the prevalence of local amenities, it is assumed that accommodations would typically be within a 20 km radius of the Proposal Site. Group transport for workstreams utilising more than 20 persons and partial ride sharing may be implemented depending on the Contractor.

Other vehicle movements associated with the Proposal would include:

- Heavy rigid: Transport of bulk materials including gravel, concrete (or components sand, gravel, cement), assume average 10 m^3 per vehicle
- Semi-trailer (2 and 3 axle): Delivery of structural, mechanical and electrical equipment (other than those requiring oversize transport), and temporary offices, lunch rooms, assume 40 tonnes per vehicle
- B-double: Fuel supply for first fill and commissioning
- Oversize: Delivery of major loads, including gas turbine, generator, generator step-up transformer, exhaust stack segments and large electrical switchroom(s)
- Cranage: Assume 2 mobile all terrain cranes, one large crawler for peak construction (approximately September 2022 – May 2023) and two mobile Franna cranes otherwise during other parts of construction
- Heavy machinery: Sourced locally and transported via low-loader, assumed to remain onsite for duration of their individual assignment (e.g. earthmoving equipment).

Forecast additional traffic due to the Proposal is summarised in Table 2.2 and discussed in Chapter 17. Passenger, heavy rigid vehicle, and heavy machinery movements would occur 6-days per week, other Proposal traffic would be confined to weekdays (Monday to Friday).

Table 2.2: Preliminary construction traffic volumes and timing

Vehicle Class	Maximum vehicle movements (per day)	Peak Times	Proposal Dates (approx.)
Passenger	400 (200 during each peak hour e.g. AM and PM)	6:00 am to 7:00 am 3:30 pm to 4:30 pm	January 2022 – December 2023
Heavy rigid	100	7:00 am to 3:00 pm	January 2022 – May 2023
Semi-trailer	20	7:00 am to 3:00 pm	July 2022 – May 2023
B-double	12	8:00 am to 4:00 pm	May 2023 – August 2023
Oversize overmass	2	Off-peak (at night)	September 2022 – November 2022
Cranage	4	Off-peak period	July 2022 – May 2023
Heavy machinery (via low loader)	4	Off-peak period	January 2022 – May 2023

The movement of oversize overmass loads would be coordinated with the National Heavy Vehicle Regulator (NHVR). An access permit would be required, and these vehicle movements would take place at night or other off-peak times. The use of these vehicles is required for the transportation of at least the heaviest Proposal components being the gas turbine units, generators, and step-up transformers. The potential route for the heaviest of oversize overmass loads is shown in Figure 2.4.

Figure 2.4: Proposed route for oversize overmass deliveries

Construction traffic coordination – Hydro Aluminium site remediation

Based on current scheduling, it is likely that the construction program for the Proposal would overlap with ongoing works by Hydro Aluminium, the current landowner, to remediate parts of the former aluminium smelter site. The Hydro Aluminium works will involve movement by truck of large volumes of material from the eastern half of the former smelter site (outside the Proposal Site), along a haul road to a containment cell located to the west of the Proposal Site.

The location of this haul road is likely to be outside but in proximity to the southern and western boundary of the Proposal Site, and would be agreed with Hydro Aluminium and the land developer prior to commencement of construction. This would minimise any disturbance or interruption to site works for either project. Construction traffic for the two simultaneous activities would be managed through a Construction Traffic Management Plan, which would be prepared in consultation with Hydro Aluminium, to ensure the safety of workers and free flow of construction traffic.

2.4.9 Building Construction Materials

A summary of approximate construction materials to be used during in the Proposal is provided in Table 2.3 below. Total quantities will be dependent upon the detailed design and will vary depending on the eventual Proposal design.

Table 2.3: Construction materials

Materials	Units	Quantity
Steel (and other metals)	tonnes	**3,300**
Concrete	tonnes	**12,000**
Gravel	tonnes	**23,000**
Clean Fill	m^3	**2,000**
Open Excavations	m^3	**22,000**
Cut (foundations)	m^3	**4,000**

2.4.10 Site laydown

During construction of the Proposal, the Contractor(s) may utilise the proposed buffer area as shown in Figure 2.1 for construction site offices, parking and additional equipment laydown.

2.5 Proposal operation

2.5.1 General

The Proposal would feature fast start heavy duty gas turbines, which are suitable for peaking power generation. The Proposal is seeking approval for a capacity factor of up to 10 per cent on natural gas and up to 2 per cent on diesel (providing a combined capacity factor of 12 per cent) in any given year. However, it is expected that likely operations would result in a capacity factor of 2 per cent in any given year. Annual start-ups would range from 50 to approximately 200 occasions per year. Start-up would take approximately 30 minutes to reach the full rated load.

The minimum gas supply pressure for a gas turbine unit is expected to be approximately 3.8 megapascal (MPa).

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

The Proposal would be staffed during regular hours of operation (see Section 2.5.2), but would be designed for unattended and fully automated operation. An integrated control system would be developed to operate the power station facility, providing a high level of automation. Control and monitoring of the facility would be from Snowy Hydro’s control centre in Cooma, with local control at the Proposal Site taken as required.

The electrical switchyard will also be designed to be fully automated and is expected to be largely unmanned during operation.

It is possible that the gas connection infrastructure (new gas lateral pipeline and gas receiving station; being developed by others) may not be completed until approximately six months after the Proposal’s commissioning. Thus, if the Proposal needed to operate within the first scheduled six months of operation, beginning approximately August 2023, it would need to operate on diesel depending on the timing for completion of construction of the gas lateral pipeline.

2.5.2 Operational hours and workforce

During operation, the Proposal would be operated remotely from Snowy Hydro's control centre in Cooma. On site staff would manage plant availability, regular maintenance requirements, functional tests, and facility upkeep. Permanent site staff numbers are not expected to exceed an average of 10 full time equivalent persons (FTE). A small number of additional support staff and deliveries of consumables, waste disposal, sanitary services, and specialist maintenance staff may also be generated on a weekly basis.

Where larger maintenance events occur, such as outages for turbine inspections, additional contract staff would attend the site, with a workforce up to approximately 30-50 personnel for the larger events.

As the electrical switchyard will also be designed to be fully automated, it is expected to be largely unmanned during operation with local operations and maintenance staff only entering the switchyard as required for specific operational requirements and when there are maintenance tasks to be completed.

It is anticipated that the power station site would be attended by staff during the hours of approximately 7:00 am – 4:00 pm weekdays. Outside of standard operating hours the site can continue to be operated remotely and a roster of staff members would be on-call to address any immediate operational or maintenance requirements.

2.5.3 Operational Traffic

During typical operation of the plant, operational traffic would consist of commuting activity by the small onsite staff (Monday to Friday) and support and maintenance staff. It is also reasonable to expect that infrequent deliveries of consumables, waste disposal, sanitary services, and specialist maintenance staff (e.g. warranty repairs as required) would be made to the Proposal Site on a weekly or as-needed basis.

Increased traffic would occur at specific intervals throughout the life of the Proposal. This is expected to occur when:

- There is a diesel fuel delivery: B-double road tankers (approximate volume of 50 kL) would be used to refill the onsite diesel storage tanks if and when they are used. The refilling of the storage tanks is dependent on the number of times and hours the plant is run on diesel and is highly variable but could be expected to occur up to three times annually. For the purposes of this EIS, it is assumed that diesel fuel delivery occurs with a maximum of six tankers per day (12 movements total), until the tanks are refilled.
- If unused, diesel may need to be replaced at approximately 12 to 24 month intervals (depending on the condition of the diesel); this may require up to 280 B-double vehicle movements in total to drain and refill the storage tanks (based on 70 tankers of 50 kL each; to drain and then refill). However, for planning and assessment purposes the assumption is a maximum of six tankers will enter Site each day (12 movements total), until the tanks are drained and refilled.
- Gas turbine inspection and maintenance: periodic minor inspections, hot gas path inspections and major inspections of each gas turbine and auxiliaries would be required. The timings of each would be largely dependent on the equivalent operating hours, starts per year, operating conditions and the service agreement philosophy adopted. The major overhaul event could increase the on-site workforce requirement by approximately 30-50 persons for a period of approximately six to eight weeks depending on the outage requirements
- Switchyard maintenance as required, although this will require a much smaller workforce compared to a gas turbine overhaul and is expected to occur very infrequently.

The expected operational traffic that would be generated by the Proposal is summarised in Table 2.4.

Table 2.4: Preliminary operational traffic volumes and timing

Event	Vehicle type	Maximum vehicle movements (per day)	Typical Arrival / Departure	Timing
Typical operation	Passenger	20 (10 during each peak hour e.g. AM and PM)	7:00 am / 4:00 pm	Weekdays
Deliveries etc.	Light commercial vehicle	4	Off-peak	Weekly
Diesel fuel refilling	B double (3 axle)	12	8:00 am / 4:00 pm	Daily during or post operation of the GT on diesel, up to 3 times per year
GT major overhaul	Passenger (cars, vans, utilities)	80	6:00 am / 4:00pm	6-week period, every ~10 years (6 days per week)
GT major overhaul	Heavy rigid (cranes, trucks)	10	Off-peak	Ad-hoc arrivals prior/finish of overhaul, every ~10 years

2.5.4 Safety and emergency response

The design, construction, maintenance and operation of the Proposal would be in full compliance with applicable legislation and Australian codes and standards, incorporating recognised international standards including a comprehensive occupational health and safety management system certified to AS 4801.

Redundancy provisions would be factored into the design, construction and operation of all plant items for:

- Gas and diesel fuel handling and conditioning equipment
- Water treatment plant and supply
- Control and instrumentation systems
- Communication equipment
- Station and instrument air.

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

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

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

The Proposal would include CCTV for crime prevention, appropriate lighting and clear and evident signage for the safety of staff and contractors. The Proposal would also include cyber security measures to protect critical electronic components of the Proposal from cyber attack.

2.5.5 Emissions to air

During normal operations, the power station would emit certain gases as a by-product of the combustion of either gas or diesel fuel, depending on the fuel being used at any given time. Emissions from the power station would include:

- Oxides of nitrogen (NO_x), including nitric oxide (NO) and nitrogen dioxide (NO_2), resulting from oxidation of atmospheric nitrogen in high temperature combustion reactions
- Carbon monoxide (CO), resulting from incomplete oxidation of fuel-bound carbon
- Sulphur dioxide (SO_2), resulting from oxidation of fuel bound sulphur
- Airborne particulate matter measured as particles of diameter less than 10 microns (PM_{10}) and as fine particles of diameter less than 2.5 microns ($PM_{2.5}$). Particulate emissions result from incomplete oxidation of fuel bound carbon; oxidation of fuel-bound sulphur to sulphate; and emission of residual ash material within diesel. Concentrations of particulate matter as PM_{10} would be proportionally higher when the power station is operating on diesel fuel.

In addition, the incomplete oxidation of fuel-bound carbon would result in airborne emissions, in smaller concentrations, of volatile organic compounds (VOCs) (e.g. acrolein, benzene, formaldehyde) and polycyclic aromatic hydrocarbons (PAHs).

Emissions to air are discussed in further detail in relation to the Proposal's potential impacts on air quality, in Chapter 15.

2.5.6 Water use

Potable and demineralised water are required to operate the Proposal. A high level summary of water types and uses is provided in the following section.

Potable water

Potable water would be used for a range of services and systems at the Proposal including:

- Input to the demineralised water treatment plant for the production of demineralised water
- Inlet air / evaporative cooling for the gas turbines
- Supply to workshops
- Amenities and administration buildings, including kitchens, safety showers, eyewash facilities, etc.
- Make-up supply for the firefighting and emergency facilities
- Plant wash down
- Landscaping irrigation.

The potable water supply to the Proposal Site would be received via a new connection into the existing Hunter Water potable water infrastructure network.

Demineralised water

Demineralised water would be produced from an on-site demineralised water treatment plant which would be supplied with potable water via the potable water storage tank or directly from the incoming potable water supply connection. Demineralised water treatment would typically entail filtration, reverse osmosis and/or electro-deionisation, or ion-exchange technology to ‘polish’ the water to produce demineralised water.

Demineralised water is used for wet compression/fogging for power augmentation, and is often applied during high ambient temperatures. The water is sprayed into the turbine inlet, to provide a cooling effect and to boost power output. Demineralised water is also used for water injection when firing the gas turbine on diesel fuel, to keep the NOx emissions within the required limits. A small amount of demineralised water would also be required for gas turbine compressor washing.

The demineralised water treatment plant would have a backwash for regeneration (which corresponds to approximately 20 per cent of the demineralised water demand) which, as process wastewater, would be neutralised before being discharged to the trade waste discharge point.

Water consumption

The estimated water demand for operation of the Proposal is detailed in Chapter 14 (section 14.3.2), with estimated water demand broken down in Table 14.5 and Table 14.6. Water tanks on site will buffer out instantaneous water demands from the Hunter Water supply connection. Water demand will be dependent on the eventual gas turbine selected for the Proposal and would be refined during the detailed design process.

The maximum estimated annual water consumption based on a 10 per cent capacity factor for gas and two per cent capacity factor for diesel fuel in any given year is estimated to be approximately 80 ML per annum. This will again be dependent on the eventual gas turbine selected for the Proposal and would be refined during the detailed design process.

2.5.7 Wastewater

The Proposal would generate wastewater streams from the operation of the Proposal, including but not necessarily limited to the following:

- Gas turbine compressor wash water
- Gas turbine evaporative cooler water blowdown
- Auxiliary closed-circuit cooling water systems (drain down events for maintenance only)
- Demineralised water treatment plant regeneration wastewater
- Chemical bund drains
- Oily water drains collected from diesel fuel storage and unloading bunds, transformer bunds and workshops

On-site oily water separators will be utilised for any dirty or contaminated stormwater areas on the Proposal Site and for any process streams such as the gas turbine compressor wash water that could be in contact with surfaces subject to diesel fuel.

The control, treatment and disposal of wastewater streams is discussed in further detail in relation to the proposed procedures for management of waste materials in Chapter 20.

2.5.8 Sewage

A new sewage reticulation system to service the Proposal Site would be constructed on the Site and will connect into the existing Hunter Water sewer infrastructure network via a new connection.

2.5.9 Solid waste

Operation of the Proposal is not anticipated to generate high volumes of solid waste. Waste streams expected to be generated include:

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

Treatment, storage and disposal of waste is discussed in further detail in relation to the proposed procedures for management of waste materials in Chapter 20.

2.5.10 Hazardous chemicals

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

The following is a list of hazardous chemicals that may reasonably be on site either within equipment or during maintenance and operation of the Proposal.

- Methane ($CH4$) / Natural gas
- Carbon dioxide ($CO2$)
- Nitrogen ($N2$)
- Sulphur hexafluoride ($SF6$) (if required)
- Acetone ($C3H6O$)
- Aerosols (propellant)
- Acids, hydrochloric acid (HCl) or sulphuric acid ($H2SO4$)
- Caustic, sodium hydroxide (NaOH)
- Chlorine remover, e.g. Sodium bisulphate
- Biocide, e.g. DNBPA based solution
- Antiscalant
- Antifoam
- Vegetation control, e.g. glyphosate ($C3H6NO5P$)
- Hydrocarbons including diesel, lubricating oil and grease.

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

3. Statutory context

3.1 Summary of statutory context

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and the Environmental Planning and Assessment Regulation 2000 (EPA Regulation) comprise the primary legislation governing land use planning and development assessment in NSW. Subordinate to the EPA Act and Regulation are other statutory instruments including State environmental planning policies (SEPPs) and local environmental plans (LEPs). These instruments embody State government planning and environment policy and local planning and land use context, respectively, as matters for consideration when decision making bodies are assessing and determining development proposals.

At the Federal level, the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as Matters of National Environmental Significance (MNES). The EPBC Act is administered by the Commonwealth Department of Agriculture, Water and the Environment (DAWE). If a proposal is likely to have a significant impact on a matter of national environmental significance, it is declared to be a controlled action under the EPBC Act and the approval of the Commonwealth Minister for the Environment is required for the proposal to proceed.

The Proposal has been declared by the NSW Minister for Planning and Public Spaces to be critical State significant infrastructure (CSSI) under section 5.13 of the EP&A Act (see Section 3.3.1). As such, the Proposal is considered to be "essential for the State for economic, environmental or social reasons", and is listed under clause 16 and Schedule 5 of State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) (see Section 3.5.1).

This chapter describes in detail the statutory provisions applying to the Proposal with respect to environmental assessment and planning approval, at the Federal, State and local levels, and the roles that these play in the Proposal's assessment and determination.

3.2 Commonwealth requirements

3.2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) aims to protect and manage nationally important flora, fauna, ecological communities and heritage places defined as Matters of National Environmental Significance (MNES). There are nine MNES listed under the EPBC Act as being protected:

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

The Commonwealth Minister for the Environment is the approval authority for any actions which:

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

The Proponent, Snowy Hydro, is a Commonwealth agency. Any action taken by a Commonwealth agency that is likely to have a significant impact on the environment is also deemed to be a controlled action.

A search of the Commonwealth Protected Matters database via the online Protected Matters Search Tool (PMST) on 23 September 2020 indicated that MNES within the area of influence of the Proposal are limited to biodiversity. Based on the results of the Protected Matters search alone, the Proposal has a potential to impact on a matter of national environmental significance. The Proposal has therefore been the subject of a referral to the Commonwealth Department of Agriculture, Water and the Environment (DAWE).

The biodiversity assessment requirements for the EIS are discussed in detail in Chapter 7. These assessment requirements are accredited under the EPBC Act through the process formalised under the *Bilateral Agreement made under section 45 of the Environment Protection and Biodiversity Conservation Act 1999 relating to environmental assessment*, made in February 2015 between the Commonwealth and the State of NSW (the Bilateral Agreement). Under the Bilateral Agreement, the Commonwealth Minister for the Environment may rely on specified environmental impact assessment processes of the State of NSW in assessing actions under the EPBC Act. The agreement formalises the accreditation of NSW processes for approval of proposed actions that would otherwise be assessed by the Australian Government for approval under the EPBC Act.

On 30 March 2021 the DAWE notified Snowy Hydro that the Proposal is “an action taken by a Commonwealth agency that is likely to have a significant impact on the environment.” The DAWE concluded that, based on the information provided in the referral, “the proposed action is likely to have a significant impact on the environment, including but not limited to:

- generating emissions and pollutants which may impact air quality, and
- potentially disturbing contaminated and/or acid-sulphate soils in the proposed action area with potential flow on impacts to surface or ground water.”

Assessment for the Proposal under the EPBC Act has been conducted through the accredited assessment process formalised under the Bilateral Agreement. However, while the Bilateral Agreement allows that one assessment may satisfy both State and Commonwealth requirements, the Proposal will still require an approval decision from both the State and Federal Ministers. At completion of the assessment process, the NSW DPIE will prepare an assessment report for the Minister for Planning and Public Spaces. In summarising the Department’s overall response to the Proposal, the assessment report will make a recommendation to the Minister as to the whether the Proposal should be approved and if so, under what conditions.

The Bilateral Agreement commits the NSW Government to providing “an Assessment Report and a recommendation to the Commonwealth on whether to approve an action and if so under what conditions, which, to the greatest extent possible, address impacts to Matters of NES so that there are not unacceptable or unsustainable impacts on those matters.”

The Proposal’s potential impacts on MNES have been considered and assessed in Chapter 7 (biodiversity), Chapter 11 (contaminated land), and Chapter 15 (air quality). This EIS is therefore considered to satisfy the requirements of the EPBC Act in respect of the Proposal’s likely impacts on the environment and on matters of national environmental significance.

As part of the formal written notice from DAWE to Snowy Hydro, it was acknowledged that DAWE had discussed the assessment with the NSW DPIE, and confirmed that no supplementary SEARs were required, as the EPBC Act matters were already covered in the NSW SEARs.

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

The *Airports Act 1996* (Airports Act) and the Airports (Protection of Airspace) Regulation 1996 (Airports Regulation) establish a framework for the protection of airspace at and around airports.

There are three airports in the general vicinity of the Proposal Site:

- Newcastle Airport, about 30 km south-east of the Proposal Site, is the Hunter region's major commercial airport, whose airfield is shared with the RAAF Williamtown air base.
- Cessnock Airport, about 13 km west of the Proposal Site, a registered airport servicing general aviation needs such as flying schools, joy flights, aircraft maintenance, helicopters and business/tourist charters.
- Maitland Airport (or Russell Field) about 9 km north of the Proposal Site, owned and operated by the Royal Newcastle Aero Club, and servicing mainly recreational and general aviation.

None of these airports meet the definition of airports to which Part 12 of the Airports Act applies (Part 12 deals with the protection of airspace around airports). Therefore, the Airports Act and Airports Regulation do not apply to the Newcastle Airport/RAAF Williamtown air base, Cessnock Airport or Maitland Airport. Although unlikely to present an aviation hazard, the Proposal's exhaust stacks have been assessed for any potential intrusion on the airports' protected airspace. Snowy Hydro has and will continue to consult closely with the Department of Defence, Newcastle Airport, Cessnock Airport, Maitland Airport, the Civil Aviation Safety Authority (CASA), Airservices Australia and local pilots associations with respect to the impact and any potential mitigation measures required for the Proposal on operations at the three airports.

3.2.3 Aviation hazard – Civil Aviation Safety Regulation 1998

CASA has identified the need to assess the potential hazard to aviation where the vertical exit velocity from gas efflux or exhaust plume exceeds 6.1 metres per second (m/s). Relevant legislation includes the potential hazard, under Regulation 139.370 of the Civil Aviation Safety Regulation 1998 (CASR 1998), and the potential danger under Regulation 6 of the Airspace Regulations 2007.

Matters relating to the potential aviation impacts of plume rise from the Proposal's exhaust are discussed in Section 10.3, and in Appendix G. The assessment documented in Section 10.3, and in Appendix G has been prepared in accordance with the CASA Advisory Circular AC 139-05 v3.0 Plume Rise Assessments (CASA, January 2019).

3.2.4 Native Title Act 1993

The *Native Title Act 1993* provides a legislative framework for the recognition and protection of native title rights that in certain circumstances allow Indigenous people to continue to hold rights to land and water, which come from their traditional laws and customs.

A search of the Register of Native Title claims on 24 September 2020 did not identify Native Title applications or determinations that affect the Proposal area.

3.3 NSW requirements: Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act* 1979 (EP&A Act) and the Environmental Planning and Assessment Regulation 2000 (EPA Regulation) establishes the planning and approvals process in NSW. The EP&A Act provides for the making of Environmental Planning Instruments (EPI), including local environmental plans (LEPs) and State environmental planning policies (SEPPs), which set out requirements for particular localities and/or particular types of development. The applicable EPIs and the Environmental Planning and Assessment Regulation (2000) (EP&A Regulation) made under the EP&A Act, collectively determine the relevant planning approval pathway and the associated environmental assessment requirements for proposed development activities.

The environmental assessment pathway under the EP&A Act is generally dependent on the location, purpose and proponent (private or NSW public authority). The scale of the development, including level of impact and/or capital investment value, will further refine the assessment process. Development can be exempt (does not require any approval or assessment) or can require various forms of approvals and assessment under Division 4.7 (Part 4) or Division 5.1 or 5.2 (Part 5) of the EP&A Act.

3.3.1 Critical State Significant Infrastructure

For the purposes of this Proposal, Snowy Hydro is considered a private proponent. Given the Proposal's purpose, scale and capital investment value, and the need for firming capacity in the NEM (see Chapter 4), the Proposal was declared by the Minister for Planning and Public Spaces to be Critical State Significant Infrastructure (CSSI) on 12 December 2020. Following gazettal of the CSSI declaration on 16 December 2020, the Proposal has been included in Schedule 5 of State Environmental Planning Policy (State and Regional Development) 2011 (see Section 3.5.2). As CSSI, the Proposal has been assessed in this EIS and requires approval from the Minister under Division 5.2 of the EP&A Act. The key implications for the Proposal, of this declaration as CSSI are as follows:

- Community participation is essential to the process for assessing and determining a CSSI project, and this EIS will be exhibited publicly for at least 28 days
- A CSSI project requires the approval of the Minister for Planning and Public Spaces before it may proceed
- Approval authorities must evaluate the merits of the CSSI project against matters in Section 5.19 of the EP&A Act, and may approve the carrying out of the project, subject to modifications or conditions, or disapprove of it
- After the Minister's determination has been given, the Department of Planning, Infrastructure and the Environment will publish the decision online, and give public notice of the reasons for the decision and how community views were taken into account in making the decision
- A CSSI project approval cannot be subject to a merit appeal
- CSSI projects may only be subject to judicial review with the approval of the Minister for Planning and Public Spaces
- Any person may commence judicial proceedings within three months of the public notice of the determination (subject to the Minister's approval)
- CSSI projects are exempt from public hearing processes through the Independent Planning Commission (IPC).

3.4 Environmental Planning and Assessment Regulation 2000

Schedule 2 of the EP&A Regulation sets out the general form and content requirements for an EIS, which is reflected in the SEARs. Table 1.2 lists all of the statutory requirements applying to the form and content of this EIS, including Schedule 2 of the EP&A Regulation and the SEARs, and identifies where in the EIS those requirements are met.

3.5 State Environmental Planning Policies

3.5.1 State Environmental Planning Policy (State and Regional Development) 2011

The State Environmental Planning Policy (State and Regional Development) (SRD SEPP) identifies development that is of regional or State significance, which includes development that has been declared State Significant Development, State Significant Infrastructure, or CSSI. Development specified in Clause 16 of the SRD SEPP provides that development specified in Schedule 5 (of the SEPP):

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

Clause 24 of Schedule 5 refers to "development for the purposes of Kurri Kurri Gas Fired Power Station Project" as being Critical State Significant Infrastructure. Therefore, it will require approval under Division 5.2 of the EP&A Act. As a result of this declaration planning instruments do not apply to the Proposal. However, the following planning instruments have been considered as part of the environmental assessment in conjunction with the SEARs.

3.5.2 State Environmental Planning Policy (Infrastructure) 2007

Under clause 34 of State Environmental Planning Policy (Infrastructure) 2007 (ISEPP), development for the purpose of electricity generating works may be carried out by any person with consent on any land in a prescribed rural, industrial or special use zone. Electricity generating works are defined in the ISEPP as "a building or place used for the purpose of making or generating electricity." Land which is zoned RU2 – Rural Landscape (current zoning under Cessnock Local Environmental Plan 2011 [see Section 3.6.1]) is a prescribed rural zone for the purposes of clause 34 of ISEPP. The likely future zoning for the land is IN3 – Heavy Industrial (see Chapter 4). Accordingly, the Project is permissible with consent under the provisions of the ISEPP.

The provisions of the ISEPP prevail where an inconsistency arises between the ISEPP and any local, regional or State policy, with the exception of the Coastal Management SEPP (which does not apply to this proposal) and the SRD SEPP, as discussed in Section 3.5.1. However as the Proposal has been declared as CSSI (see Section 3.6.1) the ISEPP and the Cessnock Local Environmental Plan 2011 do not apply to the Proposal.

3.5.3 State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33)

Under SEPP 33 developers and consent authorities are required to assess the hazards and risks associated with a proposed development before approval is given for construction and operation. A potentially hazardous industry under SEPP 33 is defined as "development for the purposes of any industry where, if the development were to operate without employing any measures to reduce or minimise its impact the development would pose a significant risk to human health, life or property or to the biophysical environment".

Developments that are classified as potentially hazardous under SEPP 33 are required by Clause 12 to have a preliminary hazard analysis (PHA) prepared to determine the risk to people, property and the biophysical environment at the proposed location and in the presence of controls.

Under section 5.22 of the EP&A Act, SEPP 33 does not formally apply to the Proposal. However, a PHA has been prepared in respect of the Proposal as required by the SEARs. The outcomes from the PHA are summarised in Section 10.1 of this EIS.

3.5.4 State Environmental Planning Policy (Koala Habitat Protection) 2019

State Environmental Planning Policy (Koala Habitat Protection) 2019 aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas. The Koala habitat SEPP applies to all local government areas (LGAs) listed within Schedule 1, including the City of Cessnock.

A biodiversity assessment has been carried out to address the Proposal's potential impacts on flora and fauna in the vicinity of the Proposal Site. The assessment, which includes the Proposal's potential impacts on Koalas and Koala habitat, is summarised in Chapter 7 of this EIS.

3.5.5 State Environmental Planning Policy No. 55 – Remediation of land

State Environmental Planning Policy 55 – Remediation of Land (SEPP 55) provides for a consistent State-wide planning approach to the remediation of contaminated land. SEPP 55 aims to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment.

Under section 5.22 of the EP&A Act, SEPP 55 does not formally apply to the Proposal. However, a contamination assessment has been undertaken for the Proposal in accordance with the SEARs (see Chapter 11), with an emphasis on potential risks to human health. This investigation has been undertaken in the context of a wider Remedial Action Plan (RAP) (Ramboll, 2016), which was prepared in support of an EIS for remediation of the former Kurri Kurri Aluminium Smelter site. The details of the RAP and its outcomes are described in Chapter 11, including the timelines, and an outline of remediation responsibilities and liabilities.

3.6 Local requirements

3.6.1 Cessnock Local Environmental Plan 2011

The Proposal Site would be located at Loxford, within the LGA of the City of Cessnock. The subject land occupies part of the site formerly occupied by the Hydro Aluminium Kurri Kurri aluminium smelter and is currently zoned RU2 Rural Landscape under the Cessnock Local Environmental Plan 2011 (Cessnock LEP). Current land zoning at the Proposal Site and surrounds is shown in Figure 1.3.

Under the Cessnock LEP, the objectives for land use and development in the RU2 Rural Landscape zone are:

- To encourage sustainable primary industry production by maintaining and enhancing the natural resource base
- To maintain the rural landscape character of the land
- To provide for a range of compatible land uses, including extensive agriculture
- To enable other forms of development that are associated with rural activity and require an isolated location or support tourism and recreation
- To ensure that the type and intensity of development is appropriate in relation to the rural capability and suitability of the land, the preservation of the agricultural, mineral and extractive production potential of the land, the rural environment (including scenic resources) and the costs of providing services and amenities
- To maintain and enhance the scenic character of the land
- To ensure that development does not create unreasonable or uneconomic demands for the provision or extension of services
- To minimise the visual impact of vegetation clearing in order to be consistent with the rural character of the locality
- To minimise disturbance to the landscape from development through clearing, earthworks, access roads and construction of buildings
- To ensure development does not intrude into the skyline when viewed from a road or other public place.

The Proposal is classified as development that would be permitted with consent in the RU2 zone.

The Minister for Planning and Public Spaces has declared that the Proposal is critical State significant infrastructure and is therefore to be assessed and determined under Division 5.2 of the EP&A Act. Schedule 5 of the SRD SEPP (see Section 3.5.1) therefore overrides the Cessnock LEP and the land use and permissibility requirements under the LEP do not apply to the Proposal.

As discussed in Chapter 4, a proposal is currently before the NSW Department of Planning, Industry and Environment (DPIE) to rezone the former smelter site and some of the surrounding land to a combination of residential, industrial, business, rural, recreation, special purpose and environmental zones. At the time of preparing this report a decision by DPIE on the proposed rezoning has not been made. However because of the CSSI declaration, the rezoning proposal will have no effect on the Proposal's statutory planning framework or its approvals pathway. If the proposed rezoning is approved however, it is expected that the future zoning for the Proposal Site would be IN3 – Heavy Industrial consistent with its proposed use for a power station.

3.7 Other relevant legislation and policies

3.7.1 Biodiversity Conservation Act 2016

Part 7 of the *Biodiversity Conservation Act 2016* (BC Act) contains provisions to assess biodiversity value impacts by a proposed development, calculating offsets and establishing market-based conservation measures, including biodiversity credits where required.

Part 7 of the BC Act requires that an application for CSSI approval under the EP&A Act be accompanied by a biodiversity development assessment report (BDAR) unless "the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values".

Biodiversity values are defined in the BC Act as:

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

The Biodiversity Conservation Regulation 2017 (BC Regulation) further defines the following as biodiversity values:

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

Given the proximity of the Proposal Site to locally and regionally sensitive areas of vegetation and potential wildlife habitat, a BDAR has been prepared by an accredited person to accompany this environmental impact statement. The BDAR is summarised in Chapter 7.

3.7.2 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) protects the natural and historical cultural heritage in NSW. It is designed to protect both listed heritage items, such as standing structures, and potential archaeological remains or relics. Different parts of the Heritage Act deal with these different situations.

Division 5.2 section 5.23(1)(c) of the EP&A Act provides that an approval under Part 4 or an excavation permit under section 139 of the Heritage Act are not required for approved State Significant Infrastructure. A cultural heritage assessment has been carried out for this EIS and is summarised in Chapter 9.

3.7.3 National Parks and Wildlife Act 1974

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

Under Section 86 of the NPW Act it is an offence to harm or desecrate an Aboriginal object or Aboriginal place. As defined under section 5 of the NPW Act, harm of an object or place includes any act or omission that:

- *a) destroys, defaces or damages the object or place, or*
- *b) in relation to an object—moves the object from the land on which it had been situated, or*
- *c) is specified by the regulations, or*
- *d) causes or permits the object or place to be harmed in a manner referred to in paragraph (a), (b) or (c),*

but does not include any act or omission that:

- *e) desecrates the object or place, or*
- *f) is trivial or negligible, or*
- *g) is excluded from this definition by the regulations.*

Clause 3A of the National Parks and Wildlife Regulation 2019 excludes the following from the definition of harm:

> *An act carried out in accordance with the Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW as published by the Department in the Gazette on 24 September 2010 is excluded from the definition of harm an object or place in section 5 (1) of the Act.*

An assessment of the Proposal's potential impacts has been carried out, in accordance with this Code of Practice, and is provided in Appendix C and summarised in Chapter 8 of this EIS. This has included formal consultation under the Aboriginal cultural heritage consultation requirements for proponents 2010 (OEH, 2010).

Under Division 5.2, Section 5.23 of the EP&A Act, an Aboriginal heritage impact permit under section 90 of the NPW Act is not required for an approved CSSI.

3.7.4 Protection of the Environment Operations Act 1997

The Protection of the Environment Operations Act 1997 (POEO Act) is the principal legislation regulating pollution and waste management in NSW. All scheduled activities as listed in Schedule 1 of the POEO Act require an environment protection licence (EPL). Schedule 1 (Clause 17) of the POEO Act includes:

- 'General electricity works', meaning the generation of electricity by means of electricity plant that uses any energy source other than wind or solar power, and
- 'Metropolitan electricity works (gas turbines)', meaning the generation of electricity by means of electricity plant that is based on, or uses, a gas turbine, and is situated in the metropolitan area or in the local government area of Port Stephens, Maitland, Cessnock, Singleton, Wollondilly or Kiama.

General electricity works are a scheduled activity if they have the capacity to generate more than 30 megawatts of electrical power, while metropolitan electricity works (gas turbines) are a scheduled activity if they have the capacity to burn more than 20 megajoules of fuel per second. The Proposal would meet the criteria for both General and Metropolitan electricity works.

Therefore, the Proposal will be a Scheduled activity and will require an EPL to operate in compliance with the requirements of the POEO Act.

An EPL cannot be issued until a project has secured a planning approval. Once planning approval has been gained, an EPL cannot be refused, and any conditions attached to the licence must be substantially consistent with the conditions of approval for the project.

3.7.5 Protection of the Environment Operations (Clean Air) Regulation 2010

The NSW Protection of the Environment Operations (Clean Air) Regulation 2010 contains provisions for the regulation of emissions to air, including exhaust stack emissions. The air emissions limits relevant for the Proposal are the 'Group 6 Standard' for scheduled premises, with the key indicators being solid airborne particles, Nitrogen dioxide (NO_2), and Sulphur dioxide (SO_2) . The Clean Air Regulation also sets limits for fuel sulphur content.

During start-up and shutdown periods, the Proposal may be exempt from the concentration standards under the Clean Air Regulation. However, practicable means must still be used to prevent and minimise air pollution.

3.7.6 NSW EPA policy – air quality assessments

The NSW Environment Protection Authority (EPA) governs air quality assessments through the Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (Approved Methods) (EPA, 2016). The Approved Methods lists the statutory methods for modelling and assessing emissions of air pollutants from stationary sources in the State, and is referred to in the Clean Air Regulation. Industry has an obligation to ensure compliance with the requirements specified in the Regulation.

A detailed discussion of air quality standards and their application to the assessment of the Proposal's potential impacts on air quality is provided in Chapter 15.

3.7.7 NSW EPA policy – noise

The Proposal's noise and vibration assessment (see Chapter 16, and Appendix L) has been guided by NSW policy and guidelines for the assessment, control and management of noise and vibration, as outlined below.

Construction noise

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

Operation noise

The Proposal's operational noise assessment has been conducted in accordance with the EPA's Noise Policy for Industry (NPI) (2017). The NPI balances the need for industrial activity with the amenity needs of the wider community, to minimise intrusive noise. The NPI sets assessment noise levels, consistent methods, and best practice measures to manage industrial noise. It applies to all new developments, and considers:

- Site specific requirements for development
- The influence of day, evening and night-time background noise levels
- Sleep disturbance criteria based on World Health Organisation guidance
- The influence of meteorological conditions
- Methods for identifying and assessing different noise characteristics such as tonal and low-frequency noise.

Road traffic noise – construction and operation

Road traffic noise from construction and operation of the Proposal is assessed against the EPA's NSW Road Noise Policy (RNP) (2011). The RNP requires that any increase in total traffic noise (construction or operation traffic) should be limited to 2 dB above that of the noise level without the development. The limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.

3.7.8 The Pipelines Act 1967 (NSW)

The *Pipelines Act 1967* (Pipelines Act) establishes the framework for the construction, licencing and operation of pipelines over land in NSW, but does not contain provisions for the planning and development approvals in relation to construction of pipelines. These provisions are made under the EP&A Act and its subordinate environmental planning instruments. The Pipelines Act does however provide for 'Authority to Survey' where a proponent requires access to private land in order to survey possible pipeline routes or conduct geotechnical or other testing, including taking of samples.

Part 3 of the Pipelines Act outlines licensing requirements for pipelines. Under Part 3 (excluding exempt items) a licence is required to:

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

A new or amended licence under Part 3 of the Pipelines Act would be required for the construction and operation of the proposed gas pipeline that would be required to support the Proposal.

A gas lateral pipeline to support the Proposal, and the gas receiving station will be designed and constructed by a third party under a separate CSSI planning approval process. Snowy Hydro will neither be the proponent, nor the constructor, owner or operator of the new gas lateral pipeline. Therefore, Snowy Hydro will not be required to apply for or hold a licence under the Pipelines Act in respect to this Proposal.

3.7.9 Roads Act 1993

The *Roads Act 1993* (Roads Act) regulates the carrying out of various activities on public roads and provides for the declaration of Transport for NSW and other public authorities, including councils, as a roads authority for different types of roads (classified and unclassified).

Under section 138 of the Roads Act, the consent of the appropriate roads authority is required before a person can erect a structure, carry out work in, on or over a public road or dig up or disturb the surface of a public road.

The construction of the Proposal may require works within public roads. However, under section 5.24 of the EP&A Act, any permit required under Section 138 of the Roads Act from the appropriate roads authority cannot be refused if it is necessary for carrying out approved State Significant Infrastructure, and is substantially consistent with the approval under Division 5.2.

3.7.10 Rural Fires Act 1997

The *Rural Fires Act 1997* facilitates the prevention, mitigation and suppression of bush and other fires in local government areas and parts of the State considered to be rural fire districts. The Proposal is considered to be located on bushfire prone land. As the Proposal is CSSI, under section 5.23 of the EP&A Act there is no requirement for a bush fire safety authority to authorise the Proposal under section 100B of the *Rural Fires Act 1997*.

The risks to the Proposal associated with its location in the vicinity of bushfire-prone land have been assessed as part of this EIS, in Section 10.2.

3.7.11 Water Act 1912 and Water Management Act 2000

The *Water Act 1912* (Water Act) identifies water management authorities (such as the Hunter Water Corporation), and governs the issue of new water licences and the trading of water licences and allocations. The application of the Water Act is limited in circumstances where the *Water Management Act 2000* applies.

The *Water Management Act 2000* (WM Act) provides for the sustainable and integrated use and management of water resources in NSW. The WM Act controls the extraction of water, its use, and the carrying out of activities on or near water sources. Under the WM Act, certain approvals are required in order to extract from a water source defined in a water sharing plan.

The Proposal would rely on water mains (potable) supply for all of the Proposal's operational needs. Therefore, no approvals or access licences would be required for the Proposal's construction or operation.

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

3.7.12 Hunter Water Regulation 2015

The Hunter Water Regulation 2015 provides for the regulation of activities within certain areas in the Hunter Region, as defined in Division 2 of the Regulation as 'special areas'.

The Regulation describes restrictions to works in special areas. Clause 8(1) provides that the owner or occupier of land in a special area must not erect, install or operate any on site sewage management facility. Clause 10(1) provides that a person must not pollute waters on the land in a special area.

The Proposal is not in a defined special area, and would not involve any treatment of sewage, or pollution of waters. Further, as the Proposal would also require an environment protection licence, Division 2 of the Regulation does not apply.

4. Strategic context and project need

4.1 Project objectives

The Proposal's overall purpose is to provide dispatchable capacity and other network services to the NEM which can be used by AEMO to meet the requirements of the NEM, and to supplement Snowy Hydro's generation portfolio with dispatchable capacity when the needs of electricity consumers are highest. Importantly, open cycle gas fired generation capacity provides firming of renewable generation projects' intermittent electricity supply to the NEM. Without dispatchable and firming generation or storage, a power system that is solely reliant on intermittent renewable generation will have unacceptable levels of customer supply failure.

4.2 Project need

AGL has announced that the 2000 MW coal-fired power station located at Liddell, NSW will be retired in stages, with one unit to shut down in April 2022 and the remaining three units in April 2023 (AGL, 2020). The Report of the Liddell Taskforce (Commonwealth of Australia and NSW Government, 2020) found that the closure of the Liddell power station by 2023 would represent a withdrawal of around 13 percent of NSW's electricity supply. The modelling presented in the report indicated that depending on the market's response to deliver new capacity, this could lead to a NSW wholesale price increase from the low $60s per MWh in 2022 to between $75 and $80 per MWh in 2023–24. The modelling presented in the report also found that maintaining price, reliability and security outcomes could be achieved through a combination of options including new gas fired generation.

In order to provide a reliable supply of energy, intermittent energy such as wind and solar needs to be firmed. In the longer term, firming could come from a range of sources. The cost of batteries is falling, making storage an increasingly commercially viable option. However, neither will be able to meet the shortfall in generation that will accompany the closure of Liddell in 2023.

In its Advice to *Commonwealth Government on Dispatchable Capability* (AEMO, September 2017), AEMO reported that the NEM will need as much as 1,000 megawatts of additional new flexible and dispatchable resources to replace the contribution of Liddell. However, the reserve requirement would increase if either projected new resources (e.g. Queensland-NSW Interconnector and Victoria-NSW Interconnector upgrades) do not come online as currently forecast, more generation is retired, or any existing generators were to suffer catastrophic failure or sustained long term outages.

The AEMO's 2019 Electricity Statement of Opportunities (ESOO) indicated that with committed projects and the interconnector upgrades, around 215 MW of new dispatchable supply would be required to ensure NSW only has a one-in-ten year risk of a significant involuntary load shed event in summer 2023–24, following a Liddell closure (Liddell Taskforce, 2020, op.cit).

There is therefore a clear need to fill this gap in dispatchable capacity, and to provide the firming capacity that will achieve the necessary reliability in the overall energy supply system. The Proposal's primary aim is to meet this need.

Explanation of the electricity market and generation technology mix, in the context of the need for the Proposal, is provided below.

4.2.1 Industry rules and governance

The electricity supply in the eastern part of Australia is served by the NEM. Electricity systems must be balanced with respect to supply (electricity generation) meeting demand (electricity consumption) continuously (virtually every second) or else the system will become unstable and fail, which would cause widespread blackouts and very high economic costs on electricity users.

The system and market operator, the AEMO, undertakes the balancing process in real-time by dispatching generation (and sometimes controllable loads) to match the varying customer loads. To avoid involuntary load shedding, sufficient generation capacity must always be available. The National Electricity Objective, which is incorporated within the National Electricity Law is:

> *"The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long-term interests of consumers of electricity with respect to—*
>
> *- price, quality, safety, reliability and security of supply of electricity; and*
>
> *- the reliability, safety and security of the national electricity system."*

All market participants in the NEM are bound by the National Electricity Law and Rules, which have the force of law. The rules, which are made and amended (as necessary) by the Australian Energy Markets Commission (AEMC), require "a maximum expected unserved energy (USE) in a region of 0.002 per cent of the total energy demanded in that region for a given financial year" (AEMC, 2020). Unserved energy is a measure of the amount of customer demand that cannot be supplied within a region due to a shortage of generation, demand-side participation or interconnector capacity. This 0.002 per cent standard was set at the start of the NEM in 1998 (although the definition was tightened in 2010). More recently, at its general meeting on 20 March 2020, the COAG Energy Council considered advice from the Energy Security Board (ESB) aimed at improving the reliability (resource adequacy) of the electricity system. The Council agreed to implement interim measures to deliver further reliability by establishing an out-of-market capacity reserve and amending triggering arrangements for the Retailer Reliability Obligation (RRO). Both measures will be triggered to keep unserved energy to no more than 0.0006 per cent in any region in any year (AEMC, 2020). These standards underscore the need for reliable dispatchable generation to be available in the NEM.

The Reliability Panel (an independent advisory panel forming part of the AEMC's institutional arrangements) recently concluded that the NEM's generation mix is changing from few large, centrally located thermal generation units to many small, dispersed, variable semi-scheduled units. Also, the thermal fleet is ageing, and the trend of thermal, scheduled generation withdrawing from the market has continued since 2012. In recent years, there has been significant investment in new generation capacity leading to higher penetrations of renewable, intermittent generation.

4.2.2 Firming technologies to balance supply and demand

The changing generation mix has had several impacts on reliability, including:

- Currently most of this variable renewable generation is non-dispatchable (in the absence of adequate storage capacity). AEMO cannot usually rely upon those types of generation to ramp up when a shortage emerges because the availability of this generation is dependent on the meteorological conditions at the time
- Thermal assets generally will become increasingly unreliable with age, a trend exacerbated when plants generate in hot weather and over long periods, and more frequently 'ramp' up and down to meet the required demand. The failure of some thermal units to generate at peak times has recently been a key factor in reliability events for some NEM regions
- Variable renewable energy (VRE) generators often do not generate at full capacity during peak demand times and/or may be positioned in a congested part of the network. While contributing significant energy resources during typical operating periods, they may sometimes make a limited contribution to meeting demand during peak hours, unless thermal and security constraints are overcome
- While storage (batteries and pumped hydro) are an increasing feature of the generation mix in the NEM, their relative capacity is not yet at a point that NEM-wide storage is playing a significant role in mitigating the broader changes in the generation mix (AEMC, 2020). It is noted that the Snowy 2.0 pumped hydro development is expected to play a role in changing the dynamics of this generation mix.

Until such time that sufficient energy storage systems can meet the balancing of electricity generation and consumption, generation capacity using other technologies will need to be provided to meet system objectives for reliability and security of supply. For peaking plants (i.e. where operation is only required for firming or to meet occasional shortfalls in generation capacity), this system reliability can now be achieved in two main ways: grid scale battery storage or fast-start dispatchable generation such as open cycle gas turbines. These two approaches, and the means of achieving them, are compared in further detail in Section 4.4.

Dispatchable electricity and other network services are increasingly important to the stability of the NEM as intermittent renewable energy enters the market. Open-cycle gas turbines fuelled by natural gas represent an economic and feasible technology. For times where natural gas is not available or is constrained, back-up fuel such as diesel (distillate) provides added security. Alternative fuels, such as renewable energy derived hydrogen or biofuel may become cost-effective and available at some time in the future and some of the gas turbine suppliers are already investigating using this technology.

4.3 Strategic policy context

4.3.1 Australian energy policy

The Australian Government's energy policy, 'A Fair Deal on Energy', announced in 2019, aims to put downward pressure on electricity and gas prices, encourage new reliable supply and technology, and to invest in new ways to make the energy system cleaner and more efficient. The policy comprises three major pillars:

- Delivering an affordable and reliable energy system
- Putting energy consumers first
- Taking real and practical action to reduce emissions and meet our international commitments.

The first of these three pillars outlines four key objectives, two of which directly support and underpin the justification for the Proposal:

1) Maintaining and increasing the supply of reliable electricity – including underwriting the New Generation Investments program; and supporting the Reliable Energy Infrastructure program
2) Promoting efficient investment in energy infrastructure.

Further to this, on 15 September 2020, the Commonwealth Minster for Energy and Emissions Reduction and the Prime Minister issued a joint media release stating that the Government's aim is: "Ensuring affordable, reliable and secure electricity supply". This release supports the development of the Proposal by Snowy Hydro in the event that other electricity industry participants do not step in and provide the new dispatchable energy to replace the Liddell power station in the required time frame.

The Proposal is aligned with the Australian Government's energy policy, through its key objectives of supporting the NEM to provide reliable electricity, developing energy infrastructure that is efficient, and contributing to net reductions in greenhouse gas emissions.

4.3.2 The National Energy Market

Almost every electricity consumer in NSW receives electricity from the NEM (unless they have an off-grid supply), which is a common electricity system that serves the needs of customers in New South Wales, Queensland, Victoria, South Australia, Tasmania and the Australian Capital Territory. The NEM is operated by AEMO.

AEMO evaluates the expected supply and demand balance of electricity in the NEM and publishes advice to stakeholders in:

- An Integrated System Plan (ISP), most recently published in July 2020 (AEMO, 2020)
- An Electricity Statement of Opportunities (ESOO), most recently published in August 2020 (AEMO, 2020)

A key component of AEMO's function is to compare the supply-demand balance over its outlook period against both a Reliability Standard and a Reliability Measure. As described by AEMO (AEMO, 2020):

> *"The ESOO provides technical and market data that informs the decision-making processes of market participants, new investors, and jurisdictional bodies as they assess opportunities in the National Electricity Market (NEM) over a 10-year outlook period.*
>
> *The NEM ESOO incorporates a reliability assessment against the reliability standard defined in the National Electricity Rules (NER) clause 3.9.3C and AEMO's Reliability Forecast under the Retailer Reliability Obligations (RRO).*
>
> *The Reliability Standard Implementation Guidelines describe how AEMO implements the reliability standard across its reliability processes, including the approach and assumptions in relation to the ESOO."*

AEMO's assessment of forecast reliability over the current 10-year outlook period is summarised in the ESOO. The ESOO introduces two reliability indices: the reliability standard, and the Interim Reliability Measure (IRM). The reliability standard specifies that expected unserved energy should not exceed 0.002 per cent of total energy consumption in any region in any financial year. The IRM is a tighter measure, intended to supplement the reliability standard and designed to trigger retailer reliability rules under the NER. The IRM is set at 0.0006 per cent of unserved energy, as explained in Section 4.2.1. A forecast exceedance of the IRM would trigger this rule, acting as a safety net against a potential breach of the less stringent reliability standard.

In NSW, the major influencing factor on forecast reliability is the planned retirement of the Liddell power station in 2023. The ESOO acknowledges that the reliability outlook has improved with the planned augmentation of the Queensland to New South Wales Interconnector (QNI) in 2022-23 and the development of 900 MW of local new renewable generation. However, it also highlights risks to reliability posed by extreme climate induced weather events such as the 2019-20 summer bushfires and the COVID-19 pandemic.

In NSW there is a need for 1,480 MW of generation this decade to meet the reliability standard and to meet the more stringent IRM capacity, which is expected to be called for from 2023-24. This corresponds to the announced timing for the closure of the Liddell Power Station, which has a capacity of approximately 2,000 MW.

The Proposal as planned would assist in maintaining the supply-demand balance and in satisfying the reliability standard and the IRM.

Integrated System Plan

The Integrated System Plan (ISP) has also been prepared by AEMO from 2018. It has since guided governments, industry and consumers on investments needed for an affordable, secure and reliable energy future, while meeting prescribed emissions trajectories, and triggered the processes for actionable ISP projects.

The ISP is a whole-of-system plan that provides an integrated roadmap for the efficient development of the NEM over the next 20 years and beyond. Its primary objective is to maximise value to end consumers by designing the lowest cost, secure and reliable energy system capable of meeting any emissions trajectory determined by policy makers at an acceptable level of risk.

The ISP identifies investment choices and recommends essential actions to optimise consumer benefits as Australia experiences what is acknowledged to be the world's fastest energy transition. That is, it aims to minimise costs and the risk of events that can adversely impact future power costs and consumer prices, while also maintaining the reliability and security of the power system.

The ISP has a longer time-horizon than the ESOO. The ISP identifies the following:

> *"The ISP modelling confirms that the least-cost and least-regret transition of the NEM is from a system dominated by centralised coal-fired generation to a highly diverse portfolio of behind-the-meter and grid-scale renewable energy resources that are supported by dispatchable firming resources and enhanced grid and service capabilities, to ensure the power system remains physically secure.*
>
> *ISP development opportunities are projects that do not involve a transmission asset or non-network option and include distribution assets, generation, storage projects, or demand side developments that are consistent with the efficient development of the power system.*
>
> *While the ISP Rules pave the way for actionable transmission projects through the RIT-T process, there is no similar regulatory mandate for other resources, such as generation and storage. Rather the ISP offers a signal to inform the decisions of private developers. Market design is therefore crucial for both regulated and private investment to deliver the least cost outcome for consumers.*
>
> *By 2040 the ISP development opportunities are those which support the ISP findings that:*
>
> *…*
>
> *3. 6-19 GW of new dispatchable resources are needed in support. To firm up the inherently variable nature of distributed and large-scale renewable generation, we will need new flexible, dispatchable resources: utility-scale pumped hydro, large-scale battery energy storage systems, distributed batteries, VPP and other demand side participation (DSP). New flexible gas generators could play a greater role if gas prices remained low at $4 to $6 per GJ over the outlook period. To secure the benefits of all dispatchable resources, market reforms currently being pursued through the Energy Security Board's post 2025 market design process should be continued at pace, otherwise necessary resources may not be delivered on time and the system will have to rely on other mechanisms, such as transmission investment. Market design needs to reward the increasing value of flexibility and dispatchability in complementing and firming variable generation, and in providing the other system security services currently provided by the existing generators, which are scheduled to retire*."

In line with the ISP, this Proposal provides dispatchable generation, being a 'flexible gas generator' to assist with firming up the intermittent wind and solar generation that is expected to replace dispatchable coal fired generation as the coal plants retire in the future.

4.3.3 NSW energy policy

The NSW Government released its electricity strategy, 'Affordable, reliable power for NSW' on 22 November 2019. In announcing the strategy, the NSW Energy Minister highlighted the need for low-cost alternative sources of energy to replace the generating capacity that will be lost as existing assets are retired. The Minister also promoted a focus on reliability, and the need to ensure that the benefits of renewable energy sources are realised without sacrificing reliability of the NEM.

Within the strategy it is noted that:

> *"Variable renewable energy needs to be complemented by firm and flexible power. Hydroelectricity meets these requirements by generating and storing electricity at scale. Standard hydro power generates electricity by releasing water from an elevated reservoir but does not involve pumping that water up again. Standard hydro is reliant on sufficient water supplies in the upper reservoir, as there is no capability to reuse this water. Pumped hydro involves pumping water into an elevated reservoir and releasing it to generate electricity. NSW has two pumped hydro projects – Shoalhaven (240 MW) and Tumut 3 (1,800 MW) – and numerous smaller, standard hydro projects.*

Gas-fired power stations generate electricity on demand with about half the level of emissions from coal but, given the current high input costs of gas, are typically only operated during periods of peak demand or when solar and wind are not generating. Gas generation can ramp up quickly, allowing it to dispatch quickly and currently is used to generate about 5 per cent of NSW's annual electricity.

Batteries, as a form of electrical storage, also provide multiple grid services such as frequency regulation. The cost of batteries has fallen in recent years and is expected to continue to trend downwards making batteries a more feasible, commercial firming option for wind and solar farms."

"The NSW Government's Electricity Strategy will:

1) *improve the efficiency and competitiveness of the NSW electricity market by reducing risk, cost, Government caused delays and by encouraging investment in new price-reducing generation and energy saving technology;*
2) *prompt Government to act if there is a forecast breach of the Energy Security Target which private sector projects are unlikely to address. This should be done in a way that minimises costs to consumers and taxpayers and does not give rise to moral hazard risk; and*
3) *ensure that there are appropriate powers available for Government to analyse and respond to electricity supply emergencies, if they arise" (NSW Government, NSW Electricity Strategy, November 2019)."*

The Proposal is consistent with the released NSW energy strategy as it builds essential efficiency and reliability into the network, which will be needed during the transition period as existing assets are retired. Together, gas peaking and renewable energy generation are part of a group of technologies that will provide emissions reduction while meeting the necessary rapid start up, generation capacity, plant reliability and cost effectiveness necessary to meet NSW electricity demand.

NSW Energy Infrastructure Roadmap

The State's pathway to achieving these energy policy goals is articulated in the NSW Electricity Infrastructure Roadmap (DPIE, November 2020). The AEMO's Integrated System Plan, outlined in Section 4.3.2 above, notes that the least-cost and least-regret transition of the NEM is from a centralised coal-fired generation system to a diverse portfolio of renewable energy, supported by dispatchable firming and enhanced transmission grid and service capabilities.

Modelling from the ISP has confirmed the necessary replacement generation in NSW is likely to be a mix of wind, solar, gas, and storage.

The Roadmap also recognises that Commonwealth funding of new generation investments, and investment in large-scale storage and firming capacity, will also be needed to balance the supply of variable renewable energy.

This can include fast start gas fired or bioenergy generation, which are less dependent upon meteorological conditions, to provide backup to renewable energy, transmission and storage. Gas fired generation also has the potential to be converted to zero-emissions hydrogen firing as this technology becomes more economic.

The NSW Government will establish an Electricity Infrastructure Investment Safeguard (Infrastructure Safeguard) to drive investment in Renewable Energy Zone (REZ) generation, long duration storage and firming capacity. The Infrastructure Safeguard puts in place the regulatory settings to create a long term investment signal for electricity infrastructure.

Long Term Energy Services Agreements for firming are technology neutral. Projects would be eligible to bid for firming contracts if AEMO would register them as Scheduled Generators and they satisfy eligibility criteria similar to that required for Long Duration Storage Long Term Energy Services Agreements. Gas peaking plants would need to be hydrogen ready, which would mean that the plant is capable of running on mixture of hydrogen fuel for a minimum proportion of its operating time each year. Most of the potential gas turbine equipment suppliers for this Proposal are continuing to investigate the use of hydrogen as a fuel and have tested operation with a blend of up to approximately 20-30 per cent hydrogen in gaseous fuels on some of their large industrial frame machines (similar to this Proposal). There is the potential for the Proposal's gas turbines to be fired on a certain percentage of hydrogen in the future when the technology and infrastructure becomes more economic, but this would require some modification to the power station and gas turbines.

The Proposal is considered to have an important role to play under the NSW Energy Infrastructure Roadmap and is consistent with its objectives. As a fast-start gas peaking plant, the Proposal would be a critical component in a diverse portfolio of generation capabilities that together will guarantee reliability of service during the long-term transition away from centralised coal-fired generation.

4.3.4 Hunter Regional Plan 2036

The Hunter Regional Plan 2036 (DPE, 2016) is a 20-year blueprint for the future of the Hunter region. The overall vision for the region is to be the leading regional economy in Australia with a vibrant new metropolitan city at its heart.

This vision is supported by a range of goals, directions and actions. Relevant to the Proposal is the direction to 'diversify and grow the energy sector' by among other things, promoting 'new opportunities arising from the closure of coal-fired power stations that enable long term sustainable economic and employment growth in the region'.

The Hunter Regional Plan 2036 includes a goal to diversify energy supply. Specifically, the Hunter Regional Plan 2036-Implementation Plan 2016-2018 includes Direction 12 to diversify and grow the energy sector by promoting new opportunities arising from the closure of coal fired power stations that enable long term sustainable economic and employment growth in the region. With the imminent closure of Liddell Power Station, significant local energy generation will be withdrawn from the Hunter Region. The Proposal is one of Snowy Hydro's responses aimed at offsetting this loss of generating capacity in the region by providing more than 300 MW of additional generation capacity.

The Hunter Regional Plan recognises the role of the Hunter region as the predominant location for the State's power generation. The Proposal is consistent with this Plan. Additionally, gas fired generation aligns with the objectives of the Plan by further diversifying the energy sector in the Hunter Valley.

4.3.5 Cessnock Community Strategic Plan 2027

The Cessnock Community Strategic Plan 2027 (Cessnock City Council, 2017) outlines the community's main priorities and vision for the future. The Strategic Plan outlines a vision for the City of Cessnock as 'thriving, attractive and welcoming'. Although the Plan acknowledges that coal mining and mining support services still play an important role in the region's economy, it also recognises the gradual shift away from a reliance on coal mining as a foundation of the region's economic base, and this is reflected in the main economic and environmental objectives under the Plan.

The Strategic Plan's objectives for 'a prosperous and sustainable economy' include:

- Encouraging more industry to create much needed jobs
- Supporting businesses to grow and diversify
- Diversifying the economy – "we need more than wine and tourism".

During the Plan's preparation, the Cessnock community also voiced their concerns about the natural environment, stressing the importance of a healthy and sustainable environment, the need for improved monitoring of pollution levels by industry, and investment in alternative energy sources. The community also expressed concern at the impact of the reduction in coal mining employment. Job creation and security was identified in the Strategic Plan as key economic issues for the City, with increased local employment identified as important by local residents.

The Proposal would support both direct and indirect job opportunities by the creation of jobs primarily during the development and construction period of the Proposal, economic diversification and contribute to offsetting the reduction in coal mining employment, and is an investment in alternative energy sources consistent with the Cessnock Community Strategic Plan.

4.4 Alternatives to the Proposal

The Proposal's main purpose and objective is to meet a specific need, which is to provide dispatchable capacity to the NEM when the needs of electricity consumers are highest. Gas fired generation capacity provides firming of electricity generation output and hence performs an essential function in the context of available baseload power and the intermittent electricity supply from renewable generation projects. Therefore, the Proposal would operate as a peak load generation facility, capable of supplying electricity at short notice when there is high demand or other temporary constraint in regular supply networks.

Currently, other available technologies offer few alternatives to meeting this need with the same efficiency and reliability as gas fired generation. Solar and wind power generation are becoming increasingly viable commercial solutions. However, as generators of intermittent energy, they require dispatchable electricity generation to firm their supply.

Existing coal-fired power stations are economical and efficient for meeting standard demand and continue to account for a high proportion of electricity generation in Australia. However, they are limited in their ability to meet variable demands and are a lot slower to start up and shut down, and were typically only designed for a certain number of plant starts/stops.

Hydro-electric and pumped hydro storage facilities are geographically constrained, are high cost and have long development lead times. While an important component of the generation mix in the long term, the open cycle gas generation capacity presented in this Proposal provides economic firming generation at a suitable MW capacity and capable of being installed in the near future. While battery storage can provide a similar function to an open cycle gas generation facility in terms of firming, it currently remains constrained by shorter run times (i.e. lower MWh) than a comparable gas fired plant. Until these constraints are overcome and reliable storage can be provided through renewables alone, gas peaking plants remain an appropriate and important transition technology.

Nuclear generation has not been considered as a potential alternative to the Proposal. Where used, nuclear energy provides baseload generation capacity and for cost and other reasons would not be considered a suitable technology for firming. Further, in addition to its high cost, nuclear generation would be constrained by a long development lead time that would not address the need to compensate for the closure of the Liddell power station in 2023-24.

In contrast, OCGT generators have the ability to be started quickly, and to be generating at maximum output at relatively short notice. The OCGT generators can also be operated at varying loads, down to a specified minimum, which provides for a degree of capacity control in the NEM. Similarly, shutdown is a relatively quick process, lending gas fired generation an efficiency and convenience that is well matched to its fundamental purpose.

Government energy policy at the State and Federal level (see Section 4.3.1 and Section 4.3.2) and the market mechanisms facilitated by government policy, are increasingly providing new opportunities for alternative and renewable energy providers to enter the market. The Australian and NSW governments are actively encouraging the development of renewable energy generation projects. According to the Clean Energy Council, the peak body for the renewable energy industry in Australia, in 2019 energy from renewable sources made up 24 per cent of the total generated. Further, in NSW as at March 2020, there was 3,333 MW of renewable energy projects under construction or financially committed, with an overall investment value of approximately $5.25 billion. Nationally, these values at March 2020 were over $20 billion in committed investment in approximately 11,000 MW of renewable energy generation (Clean Energy Council, 2020).

These figures suggest that not only are alternatives to the Proposal being planned, funded and developed by energy market participants including Snowy Hydro, there is the demand for them in the NEM. Snowy Hydro is itself a major provider of renewable energy through the Snowy Mountains Scheme, as well as contracting significant portions of renewable energy for its wholesale energy portfolio.

However, both the market and government policy recognise the inherent risk in over-reliance on renewable generation, without a mechanism available to provide a reliable and controlled transition towards greater renewable penetration. Therefore through the firming function that the Proposal would perform, the market is provided with a more reliable safety net, allowing renewable energy providers to operate in a more controlled environment where the intermittent nature of renewables does not pose a risk to continued supply under certain demand conditions.

4.4.1 Storage and gas fired power: comparative capabilities

Recent or current proposals to develop new grid-scale battery storage capacity into the NEM (e.g. Liddell Battery proposal; Broken Hill battery energy storage system; Hume battery energy storage system; etc) raise questions regarding the place of each technology now and in future, in the context of changing technology, requirements for energy firming, and the gradual retirement of ageing thermal generation assets.

Grid-scale batteries and gas peaking generation provide comparative capabilities in the NEM, being the firming of Variable Renewable Energy (VRE) through fast response generation, intra-day levelling of renewable energy, and network services. In summary, it is considered that a combination of these technologies is the most effective way to provide these capabilities, with gas peaking technology primarily suited to firming capacity in the NEM, particularly through the transition from thermal baseload generation to predominantly firmed VRE, with each technology having a role to play in that transition.

At the present time, and until there are significant breakthroughs in battery technologies, the cost of medium and long-term energy storage using batteries still remain high. Battery storage is therefore not being considered by industry as an achievable means of providing all the firming capacity in the NEM for the foreseeable future. Consequently, batteries are being developed to fulfil short-term roles such as intra-day energy transfer or levelling. Levelling is the storing of energy generated by VRE at times of low demand, such as the middle of the day where there may be high solar generation but low consumer demand, for dispatch into the NEM at high demand periods such as evening, where solar energy or wind may not be available yet there is high consumer demand.

Batteries are inherently limited by their storage capacity (megawatt hours or MWh) relative to their MW capacity, dictating how long they can operate in a single continuous period of generation. Conversely, a peaking power station using natural gas virtually has no restriction on when it can produce dispatchable energy within a day, and the duration for which it can continuously provide that energy across that day. It is noted that the latter must consider environmental factors, particularly emissions to air. In this regard, gas fired peaking generation produces minimal cumulative air emissions due to the low overall amount of generation across a year and operation with best practice emissions control technologies, as detailed in Chapter 15. Further, a gas fired generator with the capability to use diesel as a secondary fuel (as is the case for the Proposal), has a further level of security to generate dispatchable energy to the NEM, should the natural gas transmission system or gas market constrain the supply of gas to the power station.

The importance of this capability in the NEM is emphasised, as VRE forms an increasingly larger proportion of the technology mix and energy for baseload generation, and the need for firming capacity from peaking sources similarly increases. For a battery based component of firming capacity, as battery storage and correspondingly firming capacity increases, so would the need for energy to charge those batteries at times of low demand, which might be solar energy during the middle of the day, or coal fired generation during off peak periods. This reinforces the benefit of gas peaking forming a portion of the firming technology mix, as firm capacity requires up to two days of storage to provide a firm capacity type contract in a market. In summary, as VRE capacity increases, the economics more strongly favour increased gas generation, as smaller storages (i.e. batteries) cannot address this demand.

Other medium to long-term energy storage systems are also under consideration in the market. However, these are either in very early stages of commercialisation (for example hydrogen storage) or fulfil separate market roles.

In summary, it is considered that gas fuelled peaking generation provides an increased level of energy reliability to the NEM primarily through provision of firming capacity, with grid scale batteries providing a complementary technology. Both technologies are considered to have an important role in enabling and enhancing the transition to a future of reduced thermal generation sources.

4.4.2 Do-nothing or the base case

The implications of the 'do-nothing' or base case should the Proposal not proceed could include:

- Power shortages, most likely during times of peak demand such as during extreme weather, which may become more likely following the closure of the Liddell power station, potentially resulting in increased NEM prices and interrupted supply for NSW residents, businesses and the community
- Regional social and economic benefits including improved energy security, employment, and the stimulus created by major infrastructure investment, would not be realised
- The Proposal Site would be subjected to different environmental or social impacts that may arise from an alternative industrial use to the Proposal. These impacts may be an aggregate reduction or increase dependent upon the nature of the alternative industry proposed.

The do-nothing option, especially in the context of the impending closure of Liddell, would increase the risk of load-shedding, where peak demand is unable to be met. While the likelihood of such an event may be small, the economic and social consequences of blackouts can be significant and it is the mitigation of this risk that is a high priority of current government policy settings. Therefore, the do-nothing option would not be consistent with government policy.

4.4.3 Alternative locations

Snowy Hydro has investigated alternative locations as shown in Table 4.1 for the development of an open cycle gas fired power station of a similar MW capacity to the Proposal. This has included four alternative sites in the Newcastle region, as well as sites within Greater Sydney. At the time of assessment all sites were permissible under land-use planning.

The sites in Greater Sydney were excluded primarily due to difficulties in addressing likely noise impacts to existing neighbours, meet air emissions criteria for the Sydney airshed, and proximity to Sydney's second airport and consequent aviation impacts. The alternative sites in the Newcastle region were discounted for a variety of reasons including the land being unavailable, difficulties in addressing likely noise impacts to nearby receivers, and the aggregate costs of installing the required infrastructure (road upgrades, transmission and gas connections).

Mine subsidence was also a consideration in the Newcastle region and remains unresolved at one of the sites that was considered. All Newcastle region alternatives (except one) were greenfield sites and would incur the consequent higher overall impacts associated with a greenfield site in comparison to the brownfield option that the Proposal Site presents. The (other) brownfield option considered was Snowy Hydro's Colongra site, but this was ruled out as a viable location for an expanded open cycle power station footprint, due to the proximity of sensitive receivers.

Table 4.1: Alternative sites and shortlist selection criteria

Region	Site location	Greenfield	Brownfield	Land availability	Viable infrastructure and connections	Noise impacts	Airshed contribution	Aviation	Mine subsidence
Newcastle region	Kurri Kurri (Proposal Site)		Yes						
	Central Coast west	Yes		No		Risk			
	Lake Macquarie west	Yes			No	Risk			Risk
	Port Stephens industrial / semi-rural	Yes				No		Risk	
	Colongra Power Station		Yes	No		No	Risk		
Greater Sydney	Western Sydney semi-rural – Site 1	Yes				No	Risk	No	
	Western Sydney semi-rural – Site 2	Yes				Risk	Risk	No	
	Western Sydney industrial		Yes			No	No		

Notes:

1. Red indicates a criterion that could not be overcome. Orange indicates a criterion that presented a risk or constraint that could be overcome
2. A number of selection criteria are not shown as the site was either excluded before this was assessed, or the criterion did not raise any constraints that could not be overcome (e.g. biodiversity, water quality, heritage).

Snowy Hydro is therefore no longer actively pursuing an alternative site for this Proposal. A development such as the proposed OCGT power station requires a location that is unconstrained, accessible, and remote from other incompatible land uses. A suitable site for the Proposal therefore has specific requirements that include:

- The land must be available for the development, either through purchase or lease, and the development acceptable to nearby land owners
- Preferentially a brownfield development, to avoid the cumulative impacts associated with developing a greenfield site
- Accessibility for heavy vehicles and (ideally) close proximity to main roads
- An extensive buffer area to limit impacts on other land uses in terms of noise and visibility
- The ability to connect into gas and electrical infrastructure, either through adjacent positioning to connection points or available routes for transmission
- A lack of Aboriginal and European heritage objects or values or an ability to have these relocated should that be acceptable
- Availability of water to the site for potable water and operations

- Location in an airshed that is suitable to receive emissions from a power station, and which is positioned at a sufficient distance from airports so as not to impact aviation
- A lack of important species (flora or fauna) or ecosystems in order to have a sufficiently low level of impact on biodiversity
- Well-drained, level terrain with high flood immunity
- Stable geological and soil conditions including being unaffected by mine subsidence
- Aggregate costs from addressing site issues are economically viable for the development.

The Proposal Site exhibits all these characteristics, while also offering the following additional benefits:

- It is an established industrial site, having been used for heavy industry since 1969
- It is part of a much larger precinct being developed for an industrial estate
- It is already heavily disturbed, meaning there are few (natural) environmental constraints to its development
- It is adjacent to established electricity transmission infrastructure and does not require additional transmission lines to be constructed
- It is in reasonably close proximity to major population centres
- It is in reasonably close proximity (approximately 17 km) to the existing Sydney to Newcastle Jemena Gas Networks (JGN) gas transmission pipeline
- An option has been secured for the use of the land for a power station.

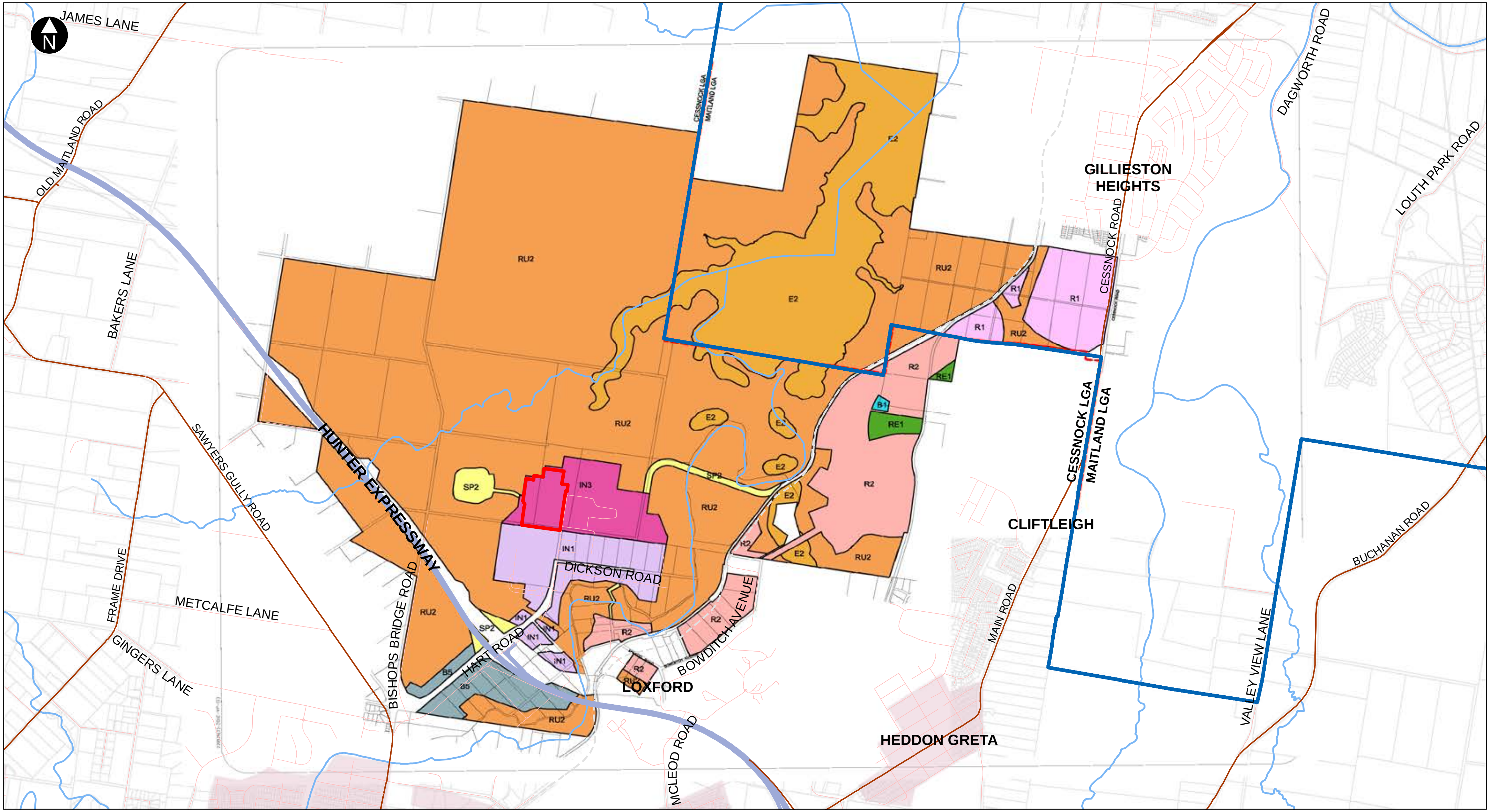
These attributes mean that the Proposal Site is extremely well suited to the proposed development of a gas fired power station. The site presents few if any obstacles or constraints to development that cannot be overcome, either through design or the implementation of measures during construction or operation, for example, to limit noise exposure or to ensure that the Proposal's operation is not resulting in any pollution or contamination of soil or water.

For the reasons outlined above in terms of the Proposal Site's physical attributes, its location and history of industrial use and the former Kurri Kurri aluminium smelter site is considered to be superior to other potential locations considered and is therefore the preferred location for the Proposal.

4.4.4 Surrounding land use compatibility

A proposal is currently before the NSW DPIE to rezone the former Hydro Aluminium smelter site and surrounding land to a combination of residential, general and heavy industrial, business, rural, recreation, special purpose and environmental zones. This would designate the Proposal Site as Heavy Industrial. However, whether the Proposal Site is eventually zoned for General Industrial or Heavy Industrial is unlikely to affect the planning outcome of this Proposal, or have any material bearing on the ultimate Ministerial determination. The Proposal would not be incompatible with the local council's land use objectives for either the current zoning or proposed rezoning type.

The proposed rezoning aims to "…respond to the development opportunities and constraints, whilst managing the interface between the future land uses." At the time of preparing this report, the proposed rezoning is awaiting DPIE's consideration and determination. The master plan concept for the rezoning, which affects land in both the Cessnock and Maitland LGAs, is shown in Figure 4.1.



Proposal Site
Urban areas
Cadastre
Motorway
Main roads
Roads
Railway
Local Government Area

B1	NEIGHBOURHOOD CENTRE (1.19ha)	
B5	BUSINESS DEVELOPMENT (33.20ha)	
E2	ENVIRONMENTAL CONSERVATION (268.51ha)	
IN1	GENERAL INDUSTRIAL (65.73ha)	
IN3	HEAVY INDUSTRIAL (53.48ha)	
R1	GENERAL RESIDENTIAL (56.57ha)	
R2	LOW DENSITY RESIDENTIAL (137.22ha)	
RE1	PUBLIC RECREATION (8.54ha)	
RU2	RURAL LANDSCAPE (1246.75ha)	
SP2	SPECIAL PURPOSE INFRASTUCTURE (12.77ha)	

0 1 2 km

1:40,000 at A4

GDA2020 MGA56

Source: McCloy Group, December 2020
Note: Subject to Planning Approval and subject to change.
This image has been georeferenced to this location.
Jacobs does not warrant that this document is definitive nor free of error and does not accept liability for any loss caused or arising from reliance upon information provided herein.

Figure 2-4 Hydro Kurri Kurri rezoning concept master plan

snowy hydro renewable energy Jacobs

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Created by : AA | QA by : KI

4.5 Summary

Gas fired generation is a proven technology which could be operational at the Proposal Site by late 2023. With a maximum capacity factor of 12 per cent being sought for approval and a more likely expected capacity factor of 2 per cent, total emissions from the Proposal would be low compared to baseload coal and given its fast start capacity, gas fired generation can be used for firming of renewable energies and as a peaking facility. The proposed gas fired power station at the Proposal Site would provide an additional viable, reliable source of dispatchable electricity into the NEM that can assist with firming of energy from renewable sources such as solar and wind, following the planned retirement of the Liddell Power Station and the increased penetration of intermittent renewables generation.

5. Stakeholder consultation

This Chapter provides a summary of consultation undertaken by Snowy Hydro with the relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners.

The SEARs require that Snowy Hydro consult with the relevant local, State and Commonwealth Government authorities, infrastructure and service providers, community groups and affected landowners.

The SEARS also require that the EIS describe the consultation process, identify the issues raised during the consultation and explain how those issues have been considered and addressed.

This Chapter describes:

- Agency responses to DPIE as part of the SEARs process and outlines where/ how Snowy Hydro has addressed them
- Consultation undertaken directly by Snowy Hydro with the various agencies
- Consultation with other key stakeholders
- The community consultation process
- Indigenous stakeholder engagement.

5.1 Agency consultation as part of the SEARs

DPIE requested input from various government agencies on the draft SEARs based on the information contained within the Scoping Report (Jacobs, 2020) in relation to the aspects to be addressed in the EIS. Table 5.1 summarises each agency's key concerns and assessment requests. The agency inputs into the SEARs was provided to DPIE and incorporated into the final SEARs at DPIE's discretion. The table also outlines how or where Snowy Hydro has addressed the agency issues/requests.

Table 5.1: Summary of agency requests to DPIE for inclusion in SEARs

Agency	Issue/ request	How/where addressed
Cessnock City Council **22 January 2021**	Cessnock City Council was uncertain about the scope of the proposed works and recommended consistency in terms of the description of the Proposal.	Chapter 2 provides a detailed description of the Proposal.
	Cessnock City Council requested the EIS to provide more information about operational details including workforce and hours of operation, and to consider *Planning Proposal 18/2015/2 – Hydro Kurri Kurri*, a proposed development which was on exhibition at the time of review.	The *Planning Proposal 18/2015/2 – Hydro Kurri Kurri* has been considered in the context of the Proposal's likely future setting, and in the assessment of the Proposal's potential cumulative impacts (see Chapter 21). However, it is also acknowledged that the *Planning Proposal* is awaiting final determination, and that until the *Planning Proposal* is approved, there are no details available regarding specific individual developments.
	Additional consultation with Airservices Australia was advised.	Requirements of Airservices Australia have been addressed in Chapter 10 and Appendix G.
	It was noted that Cessnock City Council was in support of the Proposal and recognised the benefits of the project.	Noted.
Civil Aviation Safety Authority (CASA) **14 January 2021**	CASA noted that the draft SEARs included a provision requiring the conduct of a plume rise impact assessment and considered the requirements adequate for the EIS. CASA also understood that a final assessment of the plume rise would be conducted on completion of the Proposal's detailed design. CASA commended the proponent (as documented in the Scoping Report, Jacobs, 2020) for demonstrating a good understanding of CASA's Advisory Circular AC 139-05 v 3.0 Plume Rise Assessments.	A plume rise assessment is provided in Chapter 10, with further details in Appendix G. Should key parameters of the Proposal (e.g. stack height, gas turbine size/specifications) change significantly during detailed design, a review of the plume rise assessment and associated aeronautical risk assessment may be required.
	CASA advised NSW DPIE to engage with the Department of Defence.	See below for record of consultation with the Department of Defence.

Agency	Issue/ request	How/where addressed
Department of Defence (Defence) 18 January 2021	Defence was satisfied with the SEARs requirements, particularly in relation to any plume associated impacts and potential impacts the Proposal would have on defence operations at RAAF Base Williamtown.	Plume rise assessment has been documented in Chapter 10 and in Appendix G.
	Defence requested additional engagement as the Proposal progresses, and to be informed of the outcomes of the plume assessment.	Additional consultation with Defence was undertaken as documented in Appendix G.
Heritage NSW 15 January 2021	Heritage NSW requested the EIS should identify and describe Aboriginal cultural heritage values in accordance with the *Code of Practice for Archaeological Investigation in NSW* (DECCW 2010) and guided by the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in New South Wales* (OEH 2011) Consult with Aboriginal people in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW 2010).	A comprehensive Aboriginal cultural heritage assessment has been undertaken, including consultation with Aboriginal parties and site surveys with representatives of Registered Aboriginal Parties (RAPs) in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (see Section 5.6 below).
	Assess the impacts on Aboriginal cultural heritage values in an Aboriginal Cultural Heritage Assessment Report (ACHAR). The ACHAR must outline appropriate procedures should any Aboriginal heritage objects or sites of significance be encountered.	An ACHAR has been prepared and is attached at Appendix C, and summarised in Chapter 8. The draft ACHAR was distributed to RAPs for comment prior to being finalised for the EIS.
DPIE Water; and the Natural Resources Access Regulator (NRAR) 13 January 2021	DPIE Water and NRAR recommended the following inclusion in the SEARs: Identification of an adequate and secure water supply for the life of the Proposal	The Proposal's water requirements have been considered in the EIS. As outlined in Chapter 2 and Table 2.1, the Proposal would include connection to Hunter Water's existing mains supply during construction and operation, as well as to the existing Hunter Water sewer network (under a trade waste agreement).
	A detailed and consolidated site water balance	A water balance has been prepared and is documented in Section 14.3.
	Surface water and groundwater impact assessments, including proposed mitigations and expected impacts	Groundwater and surface water impact assessments are provided in Chapters 12 and 13 respectively, and in Appendices H and I.
	Proposed surface and groundwater monitoring activities and methodologies	Recommendations for ongoing surface water quality monitoring are provided in Section 13.4.

Agency	Issue/ request	How/where addressed
	Consideration of relevant legislation, policies and guidelines, including the NSW Aquifer Interference Policy (2012), the Guidelines for Controlled Activities on Waterfront Land (2018) and the relevant Water Sharing Plans (available at https://www.industry.nsw.gov.au/water).	Relevant legislation, policies and water sharing plans have been considered and addressed in Chapters 12 and 13.
DPIE Biodiversity Conservation Division 12 January 2021	DPIE Biodiversity Conservation Division (BCD) provided standard SEARs inputs for biodiversity, water and soils, and flooding and coastal erosion. BCD requested no Proposal specific SEARs.	All biodiversity requirements have been addressed and documented in Chapter 7. The Biodiversity Assessment Report (BDAR) is attached at Appendix B.
NSW Environment Protection Authority (EPA) 21 January 2021	The EPA requested assessments for:	
	Potential noise impacts	Noise impacts are addressed in Chapter 16. A detailed noise and vibration assessment report is attached at Appendix L.
	Potential air quality impacts	Air quality impacts, and greenhouse gas assessment are addressed in Chapter 15. A detailed air quality impact assessment report and greenhouse gas assessment is attached at Appendix K.
	Water quality impacts and site water management	Groundwater assessment is provided in Chapter 12, with a detailed assessment report attached at Appendix H. Surface water quality and aquatic ecology is addressed in Chapter 13, with a detailed assessment report attached at Appendix I.
	Land and water contamination	Soils and contamination, with regard for the Hydro Kurri Kurri Aluminium Smelter Remediation project, are addressed in Chapter 11.
	Waste management and disposal	Waste management is addressed in Chapter 20.
	Furthermore, descriptions of cumulative impacts, monitoring programs and proposed environmental mitigations were requested.	A cumulative impact assessment is provided in Chapter 21. Monitoring programs and environmental mitigations are provided respectively for each chapter addressing impacts; and a consolidated summary of all mitigation measures is provided in Chapter 22.

Agency	Issue/ request	How/where addressed
Transport for NSW (TfNSW) **22 January 2021**	TfNSW requested the EIS include a traffic impact assessment that considers:	Traffic assessment is provided in Chapter 17 and a detailed traffic and transport assessment report is attached at Appendix M.
	All relevant vehicular traffic routes and intersections	The assessment has considered all major routes to and from the Proposal Site, and the capacity of key intersections. This has included a preferred route for oversize overmass vehicles.
	Current traffic counts for all traffic routes and intersections	Average annual weekday traffic volumes have been sourced from TfNSW count data. No traffic counts were commissioned specifically in relation to the Proposal. Intersection count data has not been sourced or considered in detail, as all main intersections are operating at a high level of service and have ample capacity to accommodate predicted construction and operation traffic volumes.
	Anticipated additional vehicular traffic generated from the Proposal. Assessment of the peak hour trip generation is recommended.	Traffic generated during construction and operation has been assessed including peak hour trip generation.
	Traffic impacts on existing and proposed intersections	Impacts on intersections have been assessed, but have not been modelled, as all main intersections are operating at a high level of service and have ample capacity to accommodate predicted construction and operation traffic volumes without any reduction in the level of service, and without increased road safety risk or delay.
	Necessary road network infrastructure upgrades	The assessment has shown that no road network infrastructure upgrades would be required. See Chapter 17.
	Modelling and traffic analysis of major/relevant intersections impacted	Given existing traffic volumes and network capacity, and the relatively low volumes of traffic that the Proposal would generate during construction and operation, network and intersection traffic modelling was not considered to be necessary for the Proposal's assessment.
	Impacts on regional and state road network.	Impacts on the regional and state road network have been assessed as part of the overall (desktop) assessment documented in Chapter 17 and Appendix M.

5.2 Direct agency engagement

Snowy Hydro has taken cognisance of the agency issues and requests in compiling the EIS. In addition, Snowy Hydro has engaged with many of the agencies directly in relation to their comments as documented in Table 5.1. This resulted in the following targeted consultation and meetings, either in respect of issues raised in the responses, or of issues that arose during the assessments. This direct agency engagement is summarised below.

5.2.1 NSW Environment Protection Authority

The NSW EPA was approached by DPIE on behalf of Snowy Hydro in relation to specific issues raised in their submission in response to the draft SEARs. An invitation was extended, in particular to discuss specific matters relating to construction and operational noise, air quality, and water quality. On 2 March 2021, advice was received from DPIE that the EPA had declined the offer of a meeting. However, EPA reiterated that they required the assessments to be undertaken in accordance with the SEARs, and that they would review the EIS and technical reports (Appendices) during the EIS exhibition period.

5.2.2 Civil Aviation Safety Authority

The Civil Aviation Safety Authority (CASA) was approached on behalf of Snowy Hydro on 10 December 2020 (see Appendix G), for direct engagement in the preparation of the aeronautical impact and risk assessment. In response, CASA advised that they would evaluate the proposal (and the reporting) and make a formal response after the EIS has been placed on public exhibition. Ongoing consultation throughout the assessment has continued with CASA representatives to keep them informed of technical aspects and status of the EIS process.

CASA did however strongly endorse direct consultation with a number of other aviation-related stakeholders likely to have an interest in the Proposal, including:

- Airservices Australia
- Royal Newcastle Aero Club (including Maitland Airport)
- Cessnock Airport (including Hunter Valley Aviation, Cessnock City Council, Hunter Valley Helicopters, Aerohunter Flight Training, Hunter Recreational Flying Club)
- Lake Macquarie Airport/Airborne Flight Training
- Skydive Elderslie (NSW Sport Parachuting)
- Skyline Aviation Group
- Matt Hall Aerobatic.

Two meetings were held with aviators, one at Maitland Airport and the other at Cessnock Airport with good attendance from local recreational and professional aviators. Summaries of these meetings are included in the aeronautical impact and risk assessment which is attached to the EIS as Appendix G. All of the other organisations identified were approached for comment in relation to the preparation of the aeronautical impact and risk assessment report. With the exception of the last three listed, all of these stakeholders provided a response, which can be found in Appendix G to this EIS.

A meeting was held with DPIE and CASA on 11 March 2021 to confirm inputs and consultation. The outcomes of this meeting are documented in Appendix G. There has also been ongoing correspondence with CASA relating to consultation with the Aviation State Engagement Forum (AvSEF) and in relation to some of the plume rise assumptions.

5.2.3 DPIE Hazards Team

Snowy Hydro has consulted with the DPIE Hazards Team to discuss the scope and findings of the Preliminary Hazard Assessment.

The first meeting on 4 February 2021 focused on the proposed methodology for the preliminary hazard assessment. The approach to the assessment was considered appropriate, but DPIE requested that the draft assessment results be shared with the department prior to lodgement of the EIS. It was also agreed at this meeting that there was inadequate information available for a full risk assessment in relation to the gas receiving station, and that the third party developer should undertake a detailed study as part of a future EIS for the gas lateral pipeline and gas receiving station. The DPIE Hazard Team also requested that the results of the assessment be presented for review, prior to the EIS being publicly exhibited.

At the second meeting, on 18 March 2021, the draft assessment was presented to the DPIE Hazards Team and the findings discussed. The DPIE Hazard Team concluded that the draft findings gave insufficient detail in regard to land use risk; in particular, that the analysis did not provide the necessary level of confidence in conclusions regarding incident consequences. Therefore, the Hazard Team requested that consequence analysis be provided using outputs from computer modelling using an appropriate software package. The results of this additional consequence modelling are presented in Appendix E.

5.2.4 DPIE Biodiversity Conservation Division

After receipt of the SEARs, Jacobs on behalf of Snowy Hydro contacted the BCD on 4 March 2021 to discuss the proposed biodiversity assessment and the methodology that had been developed. In summary, BCD agreed that the approach and methodology adopted, which followed the Biodiversity Assessment Method as prescribed under the *Biodiversity Conservation Act 2016*, was acceptable. It was explained to BCD that, at the time of carrying out the assessment, Snowy Hydro did not have a specific strategy for offsetting the likely loss of native vegetation (see Chapter 7 and Appendix B), but that any offset obligations would be met through a combination of purchasing available credits in the market, and paying into the Biodiversity Conservation Fund.

BCD agreed that this approach was acceptable, and requested that it be suitably explained in the BDAR (Appendix B) and the EIS (Chapter 7).

5.2.5 Transport for NSW

Jacobs on behalf of Snowy Hydro approached TfNSW by telephone on 11 February 2021 for further discussion of issues raised in their submission accompanying the SEARs, as outlined above in Section 5.1 and Table 5.1. Specifically, it was pointed out to TfNSW that Snowy Hydro's proposed methodology for assessment of the Proposal's impacts on traffic and transport differed from that outlined in TfNSW's submission, and that as the Proponent, Snowy Hydro was seeking a meeting with TfNSW to discuss these differences. In response, TfNSW advised that if Snowy Hydro proposed any different approach for the EIS Traffic and Transport Assessment, written advice to that effect was their preference, rather than a meeting.

Snowy Hydro therefore prepared a detailed explanation in respect of the EIS assessment scope and methodology for traffic and transport which was sent to TfNSW on 18 February 2021. TfNSW responded on 10 March 2021 and agreed to Snowy Hydro's methodology. They recommended that Snowy Hydro consult with Cessnock Council as the road authority for Hart Road and all other local public roads in the area and requested that assumed traffic volumes be included in diagrams.

5.2.6 Cessnock City Council

Following the written correspondence from Cessnock City Council as outlined in Table 5.1, Snowy Hydro met with Council on 10 February 2021 to present details of the Proposal, provide an update on EIS progress, and to address specific issues raised by Council. At this meeting, Council confirmed its support for the Proposal.

5.2.7 Commonwealth Department of Agriculture, Water and the Environment

A pre-lodgement meeting was held with the Commonwealth Department of Agriculture, Water and the Environment (DAWE) on 3 December 2020 in relation to the referral prepared under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). At this meeting, DAWE outlined their expectations in respect of the scope and content of the referral, which was subsequently lodged on 5 February 2021 (see Section 3.2).

There has been ongoing engagement with DAWE following lodgement of the EPBC referral. On 30 March 2021 DAWE gave formal written notification to Snowy Hydro that the Proposal constitutes a controlled action under the EPBC Act, and that the Proposal "is *likely to have a significant impact on the environment, including but not limited to:*

- *generating emissions and pollutants which may impact air quality, and*
- *potentially disturbing contaminated and/or acid-sulphate soils in the proposed action area with potential flow on impacts to surface or ground water."*

As referred to in Table 5.1, air quality impacts are addressed in Chapter 15 and Appendix K, while soils and contamination are addressed in Chapter 11 and Chapter 12.

5.3 Other key stakeholder consultation

5.3.1 Hunter Water Corporation

Snowy Hydro has been in contact with Hunter Water during the Proposal's development phase including two meetings, the first in September 2020 and the most recently, on 18 February 2021. In addition to these meetings, there has been written and email correspondence, including a letter dated 25 February 2021 formalising the general advice in regard to water and sewer issues relevant to the Proposal.

Hunter Water has confirmed that potable and wastewater/trade waste services are available to serve the Proposal from the Dickson Road/Hart Road intersection, subject to Hunter Water's usual application and permitting processes, and the necessary detailed investigations. These activities would take place during detailed design for the Proposal, and Snowy Hydro would continue to liaise directly with Hunter Water throughout this process.

5.3.2 Ausgrid

Snowy Hydro has been engaging with Ausgrid on an ongoing basis with regard to the Proposal, in relation to advancing a connection application, any works that might be required in the Ausgrid easement, disconnection of the existing (Hydro Aluminium) Transformer Yard, and the proposed new 132 kV switchyard. Formal responses from Ausgrid are noted below.

- 24 July 2020 — Ausgrid provided a *Schedule 5.4A Preliminary Enquiry Response* to Snowy Hydro's enquiry to connect a power station at the Proposal Site
- 11 September 2020 — Ausgrid provided a *Schedule 5.4B Detailed Enquiry Response*
- 16 February 2021 — Ausgrid provided a response *1900104762 – Easement enquiry – Kurri 132 kV – Construction of stormwater basin* outlining technical standards in relation to the stormwater basin proposed to be constructed within the Ausgrid 132 kV easement.
- 3 March 2021 — Joint kickoff meeting with representatives from Ausgrid, Transgrid, and Snowy Hydro to discuss the Proposal schedule, performance requirements, and process steps to enable the connection agreement and physical electrical connection process.

The formal connection application is expected to be submitted by Snowy Hydro following submission of the EIS, selection of the equipment manufacturer for the Proposal, and completion of the required system modelling studies.

5.3.3 Current landowner and developer

Snowy Hydro has been engaging with the ReGrowth Kurri Kurri area developer, the McCloy Group, and Hydro Aluminium Kurri Kurri Pty Ltd, the current land owner of the former smelter site throughout the development of this EIS. The ongoing engagement has facilitated access to the Proposal Site and surrounds to enable the environmental assessments to be conducted for the EIS, and arrangements for the transfer of land to Snowy Hydro for the Proposal. Hydro Aluminium representatives are also part of the Community Working Group established as part of the process to address the consultation requirements outlined in the SEARs. The engagement and ongoing consultation will be continued throughout the EIS assessment process.

Snowy Hydro formally notified Hydro Aluminium Kurri Kurri Pty Ltd as the owner of the Proposal Site, on 21 December 2020 that Snowy Hydro had made a planning application, as required by Regulation 193 of the NSW Environmental Planning and Assessment Regulation 2000.

5.4 Community consultation

Scope of engagement

This section covers community engagement carried out during the planning stages of the Proposal (see Figure 5.1). The scope of this engagement covered:

- Informing the community of the scope and timing of the Proposal, and potential interactions with development in the vicinity
- Advising potentially affected stakeholders of the Proposal's possible impacts during construction and operation
- Establishing processes to inform the nearby community and engage directly with community members (detailed below)
- Identifying perceived impacts to help inform the investigations for the environmental impact studies
- Integrating community concerns, advice, and local knowledge into the EIS and assessments
- Advising stakeholders on how they may obtain further information or communicate concerns, complaints or suggestions.

The key steps in the community engagement process during EIS preparation have included:

- Announcement of the Proposal, and establishment of dedicated Proposal email address, 1-800 hotline number and webpage
- Letterbox drops to 309 residences within 3 km of the Proposal Site
- Three Community Working Group (CWG) meetings, on 10 March, 30 March and 12 April 2021, the third conducted at the request of the CWG
- Door-knocking at 38 residences and businesses within 2 km of the Proposal Site
- One-on-one meetings with nearby residents as requested.

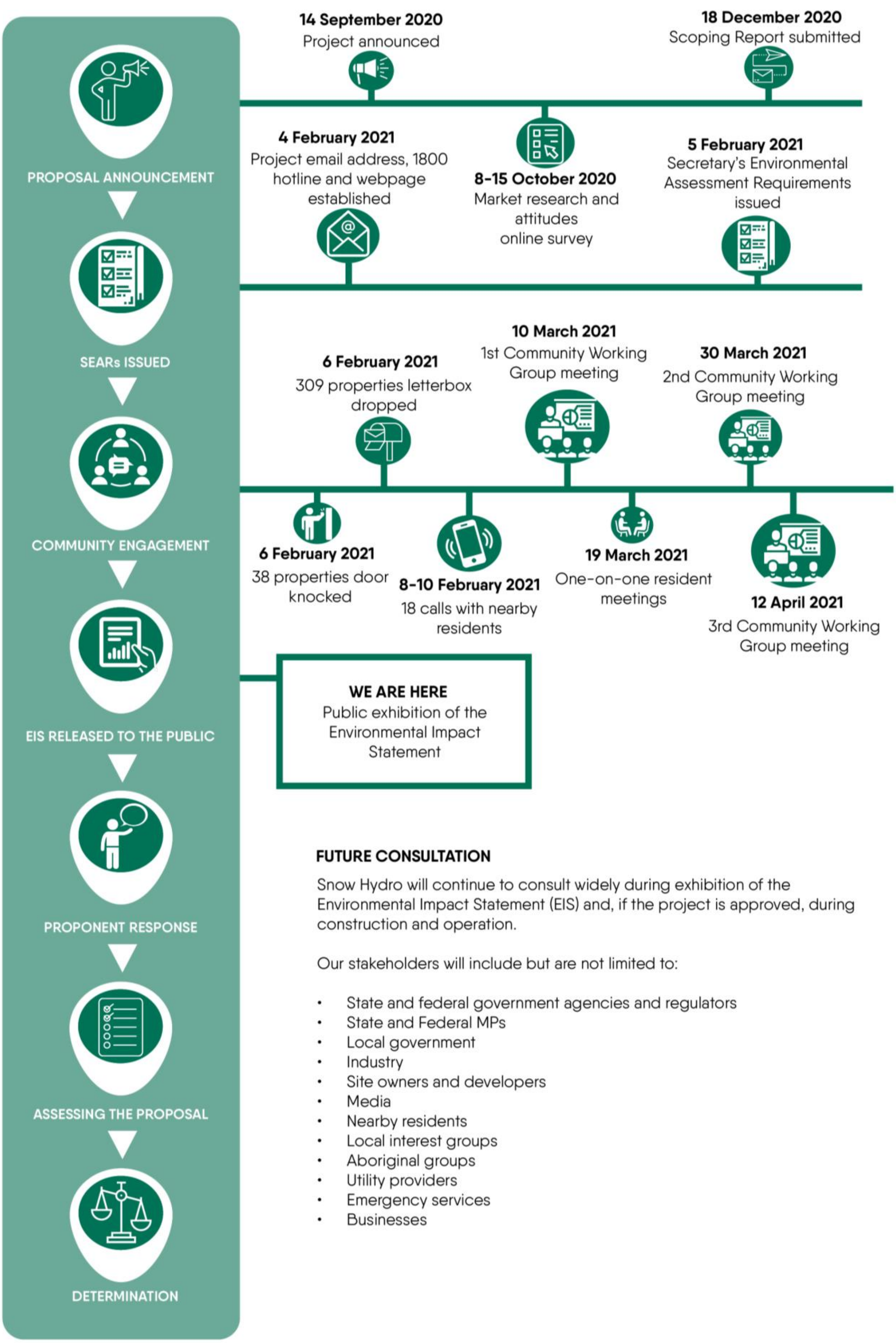


Figure 5.1: Community engagement process

5.4.1 Engagement approach

Community engagement for the Proposal was guided by the International Association for Public Participation (IAP2) Spectrum of Engagement, which provides a framework for community and stakeholder engagement and is recognised by local Councils and State Government agencies across Australia.

The level of engagement for this Proposal was also guided by DPIE (Draft) Community and Stakeholder Engagement guidelines (DPE, 2017), and the 'Approach to Engagement Worksheet' (DPIE, undated) for preparing the Proposal Scoping Report and then the EIS.

5.4.2 Community stakeholder identification

Snowy Hydro sought engagement with a wide range of community stakeholders as part of the planning and environmental assessment for the Proposal, to complement the agency, utility and government stakeholders engaged with prior to and during the EIS assessments.

As discussed in Section 5.2 and Section 5.3, and as required by the SEARs, at the Proposal's inception Snowy Hydro identified stakeholders who may have an interest in, and/or may be impacted (positively or negatively) by the Proposal.

With respect to community stakeholders these included:

- Nearby residents, property owners and businesses with a 4 km radius of the Proposal Site. This was identified as being the area where residents and businesses are most likely to be interested in the Proposal
- The Cessnock, Kurri Kurri and broader community
- The local business community
- Local interest groups such as community groups, environmental groups and resident groups
- The Community Reference Group for the Hydro Kurri Kurri Site Redevelopment Project.

The extent of door-knocking and letterbox drops conducted for the Proposal in relation to the Proposal Site is shown in Figure 5.2 below.

Figure 5.2: Area of door-knocking (pink dots) and letterbox drops (green dots) (source: Newgate Communications)

5.4.3 Community engagement tools

Community engagement tools included a dedicated webpage, email address, and free 1800 phone number, to assist stakeholder and community to contact the Project team. Information included on the webpage included an overview and description of the Proposal, site and locality maps, key matters to be addressed in the EIS and the EIS process, information about how to become involved and how community feedback is being used, and answers to frequently asked questions.

The webpage address is www.snowyhydro.com.au/hunter-power-project

Email address: communityconsultation@hunterpowerproject.com.au

The engagement tools will continue as a communication and correspondence channel as the Proposal progresses.

Community Working Group

The Proposal team held formal meetings/presentations through a Community Working Group (CWG) and with one-on-one meetings with a potentially affected residences as requested.

Snowy Hydro invited residents, business stakeholders and local organisations to be part of a Community Working Group, and as such, the CWG members were a combination of self-identified and positively identified participants. The CWG participants consist of:

- Residents living near the Proposal Site
- Community members not living near the Proposal site but in the Cessnock LGA
- Two Cessnock City Council representatives (staff)
- One Cessnock City Council Councillor
- The General Manager from Hunter Business Hub

- The Aboriginal Engagement Coordinator from TAFE NSW (Kurri Kurri Campus)
- CEO of Mindaribba Local Aboriginal Land Council.

Table 5.2 describes the issues addressed at each of three meetings prior to the EIS Exhibition.

Table 5.2: Issues addressed at CWG meetings

Details	Attendance	Meeting topics
Meeting 1 Wednesday 10 March 2021	Proposal team: 8 Panel attendees: 21 (7 positively identified, 14 self-identified)	▪ The energy sector: history, current status, purpose of gas energy, and role of Snowy Hydro ▪ Environmental impacts: ecology investigations completed, implementation of biodiversity offsets ▪ Introduction to the planning process and EIS investigations
Meeting 2 Tuesday 30 March 2021	Project team: 7 Panel attendees: 20 (6 positively identified, 14 self-identified)	▪ More detailed information on the Proposal's location, and its relationship to surrounding development ▪ Project justification and Snowy Hydro's local focus for procurement and employment ▪ Ecology: further information on biodiversity assessments and predicted impacts ▪ Air quality: details on the nature, levels and frequency of emissions ▪ Noise: details on noise assessments and their results for predicted operational noise
Meeting 3 Monday 12 April 2021 6-8 pm Kurri Kurri TAFE	Project team: 6 Panel attendees: 16 (6 positively identified, 10 self-identified)	▪ Health: how the EPA air quality guidelines are set, and work to protect human and community health in the context of existing site contamination and the power station's operations ▪ Diesel emissions: the role of diesel for the proposal and its likely outputs during operations ▪ Snowy Hydro have selected APA as the third party developer and operator of the gas lateral pipeline: details of location and specifications of the infrastructure ▪ Noise: predicted construction and traffic impacts ▪ Wildlife: expected direct and indirect impacts ▪ The EIS process and opportunity for comment during exhibition

5.5 Consultation outcomes

5.5.1 Community feedback

The issues raised by stakeholders and the community for consideration by the Proposal can be grouped under the headings:

- Strategic justification and project need
- Project alternatives
- Construction impacts in relation to:
  - Traffic
  - Noise
  - Flora and fauna
  - Construction of the connecting gas pipeline

- Operational impacts in relation to:
  - Air quality – from operation on both gas and diesel
  - Community health
  - Noise
  - Fauna
- Cumulative impacts with the planned development at the Hydro Aluminium Kurri Kurri site.

Questions, comments and issues raised by the community have been recorded in a consultation database and are summarised below in Table 5.3. This feedback is grouped by issue and Snowy Hydro's response and/or the reference to where the issue has been addressed in the EIS.

Table 5.3: Summary of community feedback

Issue category	Issue raised	Snowy Hydro's response	EIS reference (where applicable)
Proposal feasibility, justification and need	▪ The cost to operate the plant ▪ Overall project cost ▪ Funding source	▪ The Proposal would represent a significant investment into the Hunter economy ▪ Snowy Hydro is owned by the Federal Government	Sections 23.1.4, 23.3.4
	▪ The benefit compared to its operational hours	▪ The Proposal capacity factor sought for approval and likely operating hours were explained	Sections 2.1, 4.5
	▪ Need for the Proposal	▪ Dispatchable electricity is increasingly required as more intermittent renewables enter the NEM ▪ Peaking gas plants and pumped hydro are key enablers of decarbonisation	Section 4.2 Section 4.2.2
	▪ Preference for renewables	▪ The comparative roles and capabilities of battery based generation and gas fired generation	Sections 4.2.2, 4.4.1
	▪ Support/opposition for the Proposal	▪ Proposal will assist in meeting the gap in electricity demand following retirement of Liddell Power Station (this will reduce NSW's electricity supply by around 13%).	Section 4.2
	▪ Overall Proposal timeframes	▪ Following community consultation, EIS will be submitted to DPIE and if approved construction could start in Q1 2022.	Section 1.1

Issue category	Issue raised	Snowy Hydro's response	EIS reference (where applicable)
	▪ Alternatives for the Proposal	▪ Other available technologies offer few alternatives to supply electricity at short notice with the same efficiency and reliability as gas fired generation	Section 4.4
Proposed gas pipeline	▪ Proposed route for gas pipeline ▪ Property impacts and timing	▪ APA, the proposed developer and operator of the gas lateral and associated infrastructure, is currently gathering data and completing a comprehensive desktop assessment to identify potential pipeline alignment ▪ This is a separate process and the community/ stakeholders will be invited to participate in this process as it progresses	Within the scope of the third party gas pipeline EIS and associated community engagement process
Air quality	▪ Location and dispersion of particulates from the stacks	▪ Ground level concentrations for particulate matter modelled for the power station compared to background air quality are negligible. Emissions data and modelling output shown to and discussed with the CWG	Section 15.3.2
	▪ Human and ecological health implications of airborne emissions	▪ The basis of EPA guidelines was described and put in national and worldwide contexts ▪ Charts and information detailing this were developed for the CWG ▪ Monitoring of emissions during operation will be done continuously in the stack and publicly reported. ▪ Incident reporting processes and regulatory oversight was described	Section 15.1.2 Section 15.5
Greenhouse gases	▪ Are emissions from gas fired plants warranted given other generation options?	▪ Emissions intensity comparisons with other generation sources and current gas fired power stations operating in the NEM were provided. ▪ As above, detailed discussion of comparative benefits of alternative generation sources ▪ Total greenhouse gas emissions expected were advised.	Section 4.4 Section 15.4.3

Issue category	Issue raised	Snowy Hydro's response	EIS reference (where applicable)
Operational noise	▪ Operational noise impact ▪ Noise modelling method and comparisons with former smelter ▪ Cumulative noise impact with Hunter Expressway	▪ Noise emissions are specified during design and verified at commissioning by the NSW EPA and NSW DPIE. ▪ Detailed modelling output was demonstrated to the CWG ▪ Basis of noise criteria and use of background noise monitoring was discussed in detail ▪ Discussions held on noise masking, reflection, absorption, and in relation to other noise sources ▪ Comparisons demonstrated with former smelter data and noise predictions ▪ Influence of weather conditions described in detail with CWG	Sections 16.1.4 16.1.6 16.2.2 16.3
Safety	▪ Storage of gas and diesel on site (explosion risk)	▪ Gas is not stored on the site ▪ Diesel would be stored in two tanks within reinforced concrete bunds designed to Australian Standards and EPA guidelines.	Section 10.1 and Appendix E
Biodiversity impacts	▪ Construction impact on fauna and flora	▪ Surveys of plants and animals, and assessment of impacts in a Biodiversity Assessment Report were described in detail with the CWG and presented graphically	Section 7.3
	▪ Biodiversity offsets – how do they work?	▪ The Proposal will require biodiversity offsets, and the options for those offsets were presented including opportunity for locally acquired, however, this will be determined in the offset plan developed following approval	Section 7.4
	▪ Operational impact on bats	▪ Further investigations into impact to bats and birds flying into the hot plume were undertaken and presented to the CWG.	Section 7.3
Aboriginal engagement	▪ Local Aboriginal Action Plan	▪ Snowy Hydro is involved in the Clontarf Foundation and will look at local social procurement opportunities during Project development	Managed outside the EIS process

Issue category	Issue raised	Snowy Hydro's response	EIS reference (where applicable)
Aboriginal heritage	▪ Artefact disturbance	▪ Preliminary investigations showed 33 registered Aboriginal sites recorded within 1 km of the site - none on site. ▪ Monitoring of deep excavations by an archaeologist and representative of Aboriginal community.	Section 8.2 Section 8.4
Economic factors	▪ Impact on local economy ▪ Opportunities for employment (including traineeships) ▪ Opportunities for local procurement ▪ Impact to land values/devaluation of adjacent land	▪ 250 jobs to be created with workers living locally and supporting the local economy. ▪ Local skills register will be set up to coincide with construction ▪ When operating the power station will employ a small number of people but will draw on local contracting services ▪ The Proposal would be constructed on what is historically industrial land earmarked for an industrial estate. No impacts identified that are expected to devalue land adjacent to Hydro Aluminium buffer lands.	Sections 23.1.4 and 23.1.5
Construction impacts	▪ Noise	The loudest predicted construction phases are: ▪ Earthworks, Installing underground services and Site surfacing. All are within the EPA criteria for construction. ▪ Detailed noise modelling and timing of these phases was presented to the CWG.	Sections 16.2.1 and 16.3
	▪ Hours of work	▪ Standard construction work hours with any Out of Hours work notified ▪ Very large items of plant would be transported at night to minimise impacts on road users.	Section 2.1
	▪ Traffic and access impact	▪ Light vehicle route assessment from Cessnock area via Government Road revised following community feedback.	Sections 17.3.1 and 17.4
Cumulative impacts	▪ Cumulative impact of developments in the local area	▪ Amenity noise criteria level and traffic considered in context of ReGrowth Kurri Kurri, construction, operation of gas pipeline and remediation work at Hydro Aluminium.	Sections 21.1, 21.3, 21.4

Issue category	Issue raised	Snowy Hydro's response	EIS reference (where applicable)
Project site location	▪ Site suitability ▪ Proximity to local residents	▪ The Proposal Site is accessible to the appropriate electrical infrastructure. ▪ Nearest residence is approximately 1 km from Proposal Site	Section 1.4 Chapter 23

5.5.2 Future consultation

Snowy Hydro is committed to ongoing consultation and engagement with the local community and stakeholder groups for the duration of the EIS, approvals phase of the Proposal, and during Project development. During the public exhibition of the EIS, the appropriate level of engagement will be undertaken to ensure a good understanding of the EIS by interested community members. This may be an open house or subsequent CWG meeting held within the vicinity of Kurri Kurri. It is expected that a CWG or Community Reference Group may continue into the operational phase of the Project. As described above, the engagement tools including the project webpage, email, and 1800 number will continue throughout.

5.6 Indigenous stakeholder engagement

Consultation with Aboriginal groups has been carried out in accordance *with Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (ACHCRP) (DECCW 2010), and is fully documented in Chapter 8 and Appendix C. During the consultation process, which commenced in November 2020, a total of 22 groups and individuals registered their interest in the Proposal.

The consultation was conducted in four stages as per the Consultation Requirements:

Stage 1 — Notification of Proposal and registration of interest (14 days from date letter sent to register as registered Aboriginal stakeholders). The list of contacted Aboriginal stakeholders is provided in Table 5.4.

Stage 2 — Presentation of information about the Proposal including draft cultural heritage assessment methodology, and invitation to comment. All parties were offered the opportunity to provide Site Officers for the archaeological survey (see Section 8.2).

Stage 3 — Gathering information about cultural significance (28 days from 27 November 2020) for registered Aboriginal stakeholders to provide a review and feedback to consultants regarding the methodology. RAPs were invited to submit information relevant to the cultural significance of the Proposal Site and any areas and objects within it, at all stages of the consultation process.

Stage 4 — Review of draft ACHAR (registered Aboriginal stakeholders had 28 days from 15 February 2021 to make a submission).

Details of consultation including meeting minutes, examples of letters sent to RAPs and knowledge holders, conversations undertaken during the archaeological site surveys, native title search results, records of cultural heritage values interviews and a detailed consultation log can be found in Appendix C. The consultation process to date is summarised in Table 8.1.

Table 5.4: List of contacted Aboriginal stakeholder organisations (Stage 1 consultation)

Name of Organisation	Date of Notification Sent	Response Received
Mindaribba Local Aboriginal Land Council	2 November 2020	No response
Native Title Services Corp	2 November 2020	No response
Office of Environment and Heritage – Hunter office	2 November 2020	Provided list of organisations to contact on 11 November 2020
Office of the Registrar, Aboriginal Land Rights Act 1983	2 November 2020	Provided contact details for Mindaribba Local Aboriginal Land Council (LALC) on 3 November 2020
Cessnock Council	2 November 2020	Provided contact details for Mindaribba LALC, Barkuma Neighbourhood Centre, Kiray Putjung Aboriginal Corporation and Wonnarua Elders Council on 4 November 2020
Hunter Local Land Services	2 November 2020	No response

The consultation requirements also stipulate notification of the Proposal in a local newspaper, with information explaining the Proposal and its exact location. Notices were placed in the Koori Mail and Newcastle Herald. These advertisements provided additional opportunity for Aboriginal people interested in the Proposal to register.

Proposal notifications were sent to all groups and individuals identified as a result of the above consultation process. A total of 22 groups and individuals registered their interest:

- A1 Indigenous Services
- AGA Services
- Awabakal Traditional Owners Aboriginal Corporation
- Cacatua Culture Consultants
- Corroboree Aboriginal Corporation
- Didge Ngunawal Clan
- DFTV Enterprises
- Divine Diggers Aboriginal Cultural Consultants
- Gunjeewong
- Lower Hunter Aboriginal Incorporated
- Kawul Pty Ltd trading as Wonn1 Sites
- Merrigarn
- Mindaribba Local Aboriginal Land Council
- Muragardi
- Murra Bidgee Muilangari Aboriginal Corporation
- Steven Talbott
- Ungooroo Aboriginal Corporation
- Wattaka Wonnarua CC Service
- Widescope Indigenous Group

- Wonnarua Elders Council
- Yarrawalk (A division of Tocomwall Pty Ltd)
- Wonnarua Nation Aboriginal Corporation.

5.6.1 Stage 4 – Review of draft ACHAR

Stage 4 of the consultation process involved the RAPs' review and feedback on the draft ACHAR (Appendix C). The draft ACHAR was sent to all RAPs on 15 February 2021, so that they could review the document and supply comments and feedback. The ACHAR was updated to incorporate the input from all RAPs at the close of the review period, which ended on 15 March 2021.

The complete summary of the consultation carried out with the Aboriginal groups for the Proposal is outlined in the ACHAR provided in Appendix C.

6. Environmental impacts

A preliminary environmental assessment for the Proposal was undertaken, and documented in a Scoping Report that supported the application to the Department of Planning, Industry and Environment for SEARs (Jacobs, December 2020). Final SEARs were issued to Snowy Hydro on 5 February 2021.

In accordance with the SEARs, specialist assessments have been undertaken in respect of the following environmental factors:

- Biodiversity Development Assessment Report; presented in Appendix B and summarised in Chapter 7
- Aboriginal Cultural Heritage Assessment Report; presented in Appendix C and summarised in Chapter 8
- Non-Aboriginal heritage Statement of Heritage Impacts; presented in Appendix D and summarised in Chapter 9
- Preliminary Hazard Assessment; presented in Appendix E and summarised in Chapter 10 (Section 10.1)
- Bushfire Risk Assessment; presented in Appendix F and summarised in Chapter 10 (Section 10.2)
- Aviation Hazard and Plume Rise Assessment; presented in Appendix G and summarised in Chapter 10 (Section 10.3)
- Assessment of electromagnetic fields; presented in Chapter 10 (Section 10.4)
- Soils and contamination assessment; presented in Chapter 11
- Groundwater Assessment Report; presented in Appendix H and summarised in Chapter 12
- Surface Water Quality and Aquatic Ecology Assessment Report; presented in Appendix I and summarised in Chapter 13
- Hydrology and Flooding Assessment Report; presented in Appendix J and summarised in Chapter 14
- Air Quality Assessment Report; presented in Appendix K and summarised in Chapter 15
- Noise and Vibration Assessment Report; presented in Appendix L and summarised in Chapter 16
- Traffic and Transport Assessment Report; presented in Appendix M and summarised in Chapter 17
- Landscape Character and Visual Impact Assessment Report; presented in Appendix N and summarised in Chapter 18
- Socio-Economic Impact Assessment; presented in Chapter 19
- Identification of waste generation and proposed management; presented in Chapter 20.

Each of the following chapters has been prepared in response to the SEARs, to address those requirements and to identify and list the recommended measures to avoid or mitigate any environmental impacts that may arise during the Proposal's construction and operation.

7. Biodiversity

A Biodiversity Development Assessment Report (BDAR) was prepared in support of the EIS to assess the Proposal's potential impacts on biodiversity. The potential impacts of the Proposal on biodiversity and recommended management measures are summarised in the following sections. The BDAR, which was prepared for the Proposal, provides further detail around the assessment methodology applied, and is provided in Appendix B of this EIS.

7.1 Assessment methodology

The NSW *Biodiversity Conservation Act 2016* (BC Act) aims to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. It establishes a framework for assessment of, and offsetting for, biodiversity impacts, as well as for investment in biodiversity conservation.

The Biodiversity Assessment Method (BAM) is established under Section 6.7 of the BC Act. The purpose of the BAM is to assess impacts on threatened species and threatened ecological communities, and their habitats, and the impact on biodiversity values, where required under the BC Act.

This chapter summarises the BDAR for the Proposal (as required under the BAM). The BDAR documents the results of the biodiversity assessment undertaken for the Proposal in line with the relevant State and Commonwealth environmental and threatened species legislation and policy. The BDAR has been prepared and peer-reviewed by specialists, accredited under Section 6.10 of the BC Act as BAM Assessors, pursuant to Part 6 of the BC Act. The Biodiversity Assessment Method Calculator (BAM-C) case number associated with the BDAR is 00021056/BAAS18058/20/00021057.

The BDAR also addresses potential impacts to biodiversity listed under the *Fisheries management Act 1994* (FM Act) and MNES identified in the EPBC Act.

7.1.1 Study area

To assess the Proposal's impacts on biodiversity, the Proposal Site and Asset Protection Zone (APZ) were surveyed, as well as the surrounding area within a 50 m buffer that may be subject to indirect impacts. The Proposal Site also includes land allocated for a proposed stormwater basin, adjacent to the Proposal's north west boundary, and overlapping with the APZ. The APZ is positioned adjacent to the Proposal Site boundary to provide a bushfire protection zone. The Proposal Site, APZ, stormwater basin, and the surrounding 50 m buffer are referred to collectively in this chapter as the study area. The locality, defined as the area within a 10 km radius surrounding the Proposal Site, was also assessed using background research and data sources. The methodology and the stages of the biodiversity assessment for the Proposal are outlined below.

7.1.2 Native vegetation and vegetation integrity

This section outlines the methods applied to assessing native vegetation within and directly adjacent to the Proposal Site.

Background research and data sources

A database search and literature review were completed as part of the desktop assessment of the study area prior to the commencement of field surveys. The review focused on database searches, relevant ecological reports pertaining to the study area and relevant Geographic Information System (GIS) data layers. The review was used to prepare a list of plant community types (PCTs) and potential Threatened Ecological Communities (TECs), to inform survey effort required for both native vegetation and threatened species assessment.

The following databases were searched or viewed:

- BioNet NSW Vegetation Classification database (accessed October-December 2020)
- The federal Department of Agriculture, Water and the Environment Protected Matters database, accessed via the online Protected Matters Search Tool (PMST) (accessed November 2020)
- Bureau of Meteorology's Atlas of Groundwater Dependent Ecosystems (GDE) (accessed October 2020)
- Department of Agriculture, Water and the Environment directory of important wetlands (accessed November 2020).

Regional vegetation mapping, geology and soil mapping projects were reviewed including:

- Vegetation of the Cessnock-Kurri Region – Extant VIS_ID 183
- Vegetation Survey, Classification and Mapping – Lower Hunter and Central Coast Regional Environment Management Strategy (Lower Hunter and Central Coastal Regional Environmental Management Strategy 2000)
- *Greater Hunter Native Vegetation Mapping: Version 4.0 IVS ID 3855* (State Government of NSW and Office of Environment and Heritage (OEH), 2010)
- Soil landscapes of the Newcastle 1:100,000 Sheet (Matthei L.E. 1995)
- *Australian Soil Classification (ASC) Soil Type map of NSW* (State Government of NSW and Office of Environment and Heritage (OEH), 2012).

Mapping extent of native vegetation cover

The extent of native vegetation mapping within the Proposal Site was ground-truthed and mapped using up to date aerial imagery. To assess per cent of current extent of native vegetation, a landscape buffer of 1,500 m was placed around the boundary of the Proposal Site in accordance with Section 3.1 of the BAM. Per cent native vegetation cover in the landscape buffer was calculated using a combination of regional vegetation mapping and aerial imagery.

Plant community type identification

The type and distribution of PCTs within the Proposal Site were identified and mapped progressively during the field surveys. The identification of PCTs presented in this Biodiversity chapter is according to the NSW PCT classification as described in the BioNet Vegetation Classification database. Each PCT was assigned to the relevant corresponding TEC where applicable. A plot-based floristic vegetation survey, as described in Section 4.3 of the BAM, was carried out in areas where the vegetated areas were of sufficient size and shape to allow for plots to be completed. The plot-based floristic vegetation surveys were carried out over two days in October 2020 (see Figure 7.1).

Using the existing vegetation mapping, survey sites (plots/midlines) were established within each area of mapped vegetation to provide a representative assessment of the vegetation prior to the field survey. Once the identification of PCTs had been finalised, each PCT was then divided into vegetation zones (an area of native vegetation that is the same PCT and has a similar broad condition state).

Vegetation zones were identified within the Proposal Site which includes the area of direct impact, a 10 m wide Asset Protection Zone (APZ) and a stormwater basin (shown in Figure 7.1) which partly overlaps the APZ.

A plot-based full floristic survey and Vegetation Integrity Assessment was carried out, according to the BAM, using a series of 20 x 20 m plots (or equivalent 400 m^2 area) nested inside a 20 x 50 m plot (or equivalent 1,000 m^2 area). Plots/mid-lines were established to provide a representative assessment of the vegetation integrity of the vegetation zone, accounting for the level of variation in the broad condition state of the vegetation zone.

Groundwater dependent ecosystems

The level of likely groundwater dependence of vegetation communities within the Proposal Site and surrounding landscape buffer has been assessed using the *Atlas of Groundwater Dependent Ecosystems* (GDEs) (Bureau of Meteorology, 2020) and the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* released by the NSW DPI (Kuginis et al., 2012). A 1,500 m landscape buffer was used to identify any aquatic GDEs within the Proposal Site and surrounding landscape.

7.1.3 Threatened species

This section outlines the methods applied to assessing threatened flora and fauna species within the study area, which incorporates the Proposal Site and directly adjacent 50 m wide buffer area.

Background research and data sources

To assess the threatened fauna species located within the Proposal Site, the Biodiversity Assessment Calculator (BAM-C) was used to derive an initial list of candidate species for the biodiversity assessment by entering likely PCTs based on regional vegetation mapping (VIS_ID 183). The results were also supplemented with database searches and review of the Threatened Biodiversity Data Collection, to identify the threatened species that have been recorded by previous surveys or are considered likely to occur in the locality and Proposal Site. The BioNet and Protected Matters databases, accessed via the Threatened Biodiversity Data Collection and the PMST, were searched for records of threatened species with a 10 km buffer of the Proposal Site.

The following databases and information sources were reviewed to prepare a list of potential threatened species for survey:

- Biodiversity Assessment Method Calculator (BAM-C) – case number 00021057
- BioNet – the website for the Atlas of NSW Wildlife and Threatened Species Profile Database – searched November 2020
- Department of Agriculture, Water and the Environment (DAWE) Protected Matters database – searched November 2020
- NSW Biodiversity Values Map and Threshold Tool – reviewed November 2020
- Important Area Maps – reviewed November 2020.

Preliminary and provisional determinations to list species and ecological communities as threatened under the BC Act were viewed on the NSW Environment, Energy and Science Group (EESG) NSW Threatened Species Scientific Committee website. At the time of writing, there are no preliminary or provisional listings of relevance to the Proposal.

Determining habitat suitability for species that can be predicted by habitat surrogates (ecosystem-credit species)

Ecosystem credit species are those threatened species where the likelihood of occurrence of a species or elements of the species' habitat can be predicted by vegetation surrogates and landscape features, or for which a targeted survey has a low probability of detection. Ecosystem credit threatened species have been assessed in conjunction with information about the Proposal Site context (Section 3 of the BAM), PCTs and vegetation integrity attributes (Chapter 4 of the BAM), and data from the Threatened Biodiversity Data Collection (Section 5 of the BAM).

The Biodiversity Assessment Calculator was used to generate a list of the predicted threatened species that met the criteria outlined in the BAM. The results of the BioNet search and PMST (Appendix F of the BDAR; see Appendix B of this EIS) were also used to inform development of the species list.

Once the initial list of predicted ecosystem credit species was generated, the geographic limitations of each species (where applicable) were examined to see if they were met. Where the Proposal Site is not within the geographic limitation described for a species, the species was removed from the predicted list of threatened species and no further assessment was undertaken. In accordance with Step 2 of the BAM an on-site assessment was then undertaken to determine the presence of any habitat constraints or microhabitats for the threatened species predicted to occur on the Proposal Site.

Under the BAM, targeted surveys are not required for ecosystem credit species. However, in some circumstances, the Threatened Biodiversity Data Collection (TBDC) may identify that a species requires assessment for ecosystem credits and species credits (a dual credit species). This occurs where part of the habitat is assessed as a species credit (e.g. breeding habitat, or locations mapped as an Important Area that is used by a species) (refer below). The remaining part of the habitat is assessed as an ecosystem credit (e.g. foraging habitat, unmapped locations used by a species).

Determining habitat suitability for species that cannot be predicted by habitat surrogates (species-credit species)

Habitat suitability is identified as the degree to which the habitat needs of threatened species are present at a particular site. Species-credit species have been assessed in conjunction with information collected about the site context of the Proposal Site (Section 3.2 of the BAM), on PCTs and vegetation integrity attributes (Section 4 of the BAM), and data obtained from the TBDC (Section 5 of the BAM). Species-credit species were assessed based on the habitat present within the study area and a review of databases and published information.

Identifying geographic and habitat constraints

Once the initial list of predicted candidate species-credit species was generated, the list was examined to determine if species should be removed from the list because the species is considered vagrant, out of geographic range or the habitat or microhabitat features are not present within the study area. The geographic limitations of each species (where applicable) were examined to see if they were met by the study area location. Where the study area is not within the geographic limitation described for a species, the species was removed from the candidate list of threatened species and no further assessment was undertaken.

7.1.4 Targeted threatened species surveys

After the candidate species list had been developed (see Section 7.2.3 and Table 7.2), targeted threatened species surveys were undertaken over two days in October 2020 and seven days in December 2020. Methods applied to the targeted threatened species surveys undertaken are outlined below.

Threatened plant surveys

After the PCTs and finer scale habitats within the study area had been identified, and the threatened species habitat assessment had been undertaken, threatened plant surveys were undertaken targeting the candidate species identified in Table 7.3.

The threatened flora surveys were guided by the methodology and effort described in the *Surveying threatened plants and their habitats – NSW survey guide for the Biodiversity Assessment Method* (Department of Planning, Industry and Environment, 2020). The main method adopted was walking parallel search transects (approximately 10-20 m spacing between observers) and with reference to the species prescribed survey timing in the BioNet TBDC. This approach was used to adequately cover the areas of potential habitat for the candidate species identified. Approximately 2 km was walked during the October and December 2020 flora surveys by a team of two ecologists.

Threatened fauna surveys

Targeted surveys were undertaken for threatened fauna where potential habitat was identified within the study area. The primary focus was on targeting threatened species identified as candidate species-credit species. Surveys included diurnal and nocturnal effort using a stratified sampling approach that aimed to sample the range of habitats present. Opportunistic observations of threatened species were also recorded during survey activities and generally while present in the study area. Surveys were focused on areas within the Proposal Site and, where possible, also occurred in adjacent habitats that extended beyond the Proposal Site, within the study area, which may be indirectly impacted by the Proposal.

Surveys were conducted during December 2020 using a combination of sampling techniques as shown in Figure 7.2. The surveys were based on the required survey period and techniques detailed for each species in the BioNet TBDC and methodology and effort as outlined in the document Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Department of Environment and Conservation, 2004) and later guidelines including:

- Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians (Department of Environment and Climate Change, 2009)
- 'Species-credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method (Office of Environment and Heritage, 2018)
- *Survey Guidelines for Australia's Threatened Frogs* (Department of the Environment Water Heritage and the Arts, 2010c).

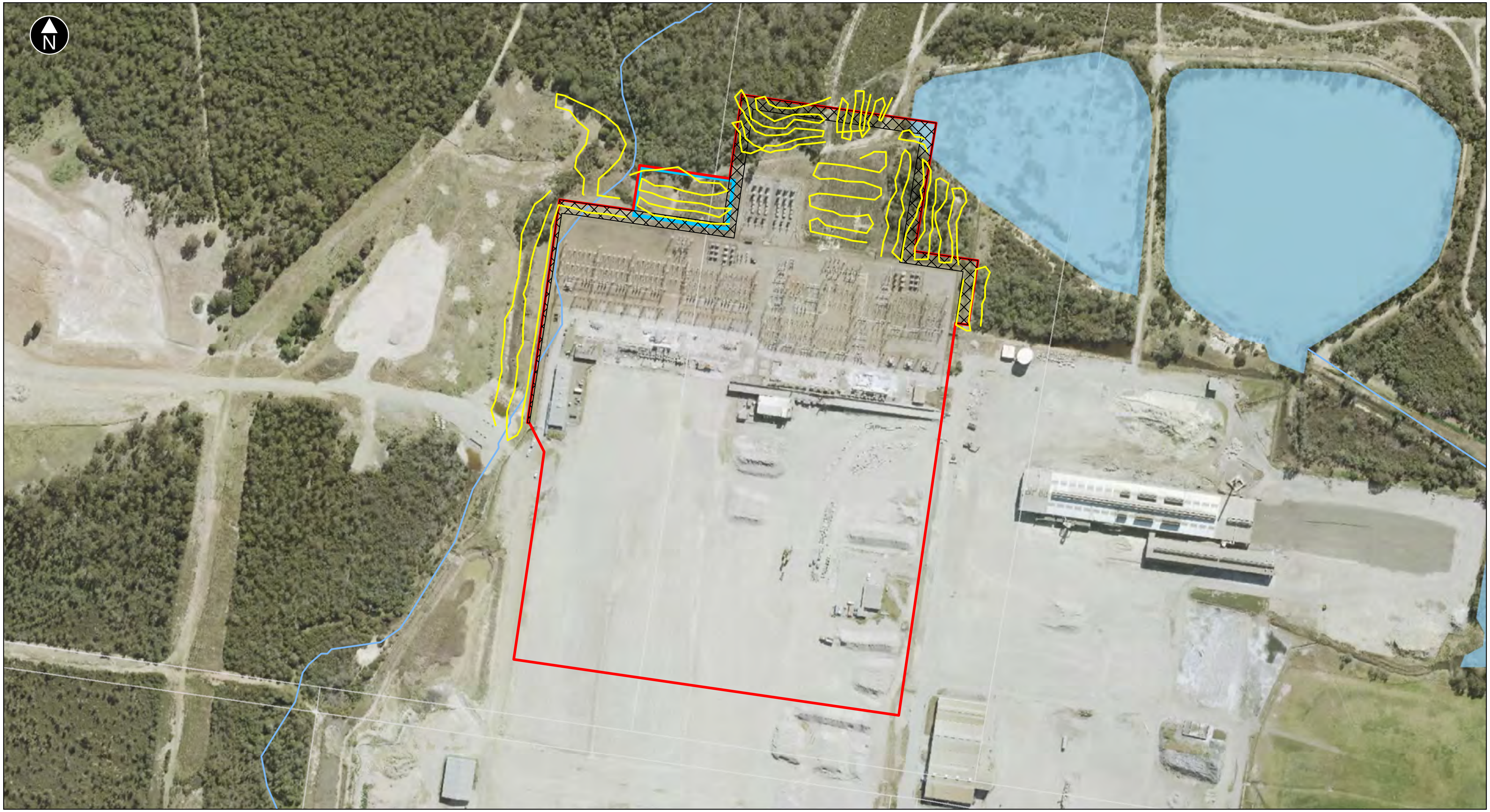
A targeted survey was conducted to identify, map and classify all hollow-bearing trees within the study area, including the Proposal Site and the surrounding APZ. Given the small area of intact vegetation within the Proposal Site, the search involved two observers covering all areas of the intact forest on site, by searching parallel transects approximately 10 m apart across the entire area. Where a hollow-bearing tree was noted this was mapped and the characteristics of the hollow recorded (i.e. height above ground and hollow-size).

7.1.5 Aquatic ecology

Aquatic habitats within the Proposal Site and broader locality were assessed against the *Policy and guidelines for fish habitat conservation and management – Update 2013* (NSW Department of Primary Industries, 2013) and *Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003). The *Aquatic Ecology in Environmental Impact Assessment – EIA Guideline* (Lincoln Smith, 2003) was used to guide the level of aquatic assessment required. There is enough existing information to describe the existing aquatic environment and to assess the quality and importance of the aquatic environments to be impacted by the Proposal. As such, this assessment was based on a review of existing information and a habitat assessment.

Searches of databases, existing mapping and other literature were used to identify the locations of sensitive receptors. Sources included:

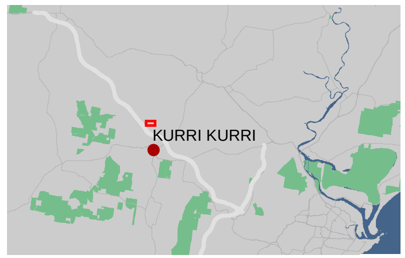
- Fisheries NSW Spatial Data Portal
- Protected Matters database accessed via the online Protected Matters Search Tool
- Atlas of GDEs (Bureau of Meteorology, 2017)
- SEED – NSW Wetlands mapping
- SEPP (Coastal Management) 2018 – Interactive map viewer
- Australian Wetlands Database (Department of the Environment and Energy, 2019).



Proposal site
Flora transects
Asset protection zone
Waterbodies
Detention basin

0 125 250 m

1:4,000 at A4
Coordinate System: GDA2020 MGA Zone 56



Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 7-1 Threatened plant surveys

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Created by : AA | QA by : KI

Proposal site
Asset protection zone
Detention basin
Waterbodies

Fauna survey locations
Bat Call Detector
Camera trap
Frog Call Playback
Harp Trap
Koala scat search plot
Elliott Trap Lines

0 125 250 m

1:4,000 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 7-2 Targeted threatened fauna surveys

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Created by : AA | QA by : KI

7.2 Existing environment

This section summarises the existing key biodiversity values within and around the Proposal Site, including:

- Flora (including ecological communities)
- Fauna
- Groundwater dependent ecosystems
- Aquatic ecology.

7.2.1 Threatened Flora

This section describes PCTs in terms of their floristic composition, geological substrate and relevant regional vegetation classification. The landscape within and immediately surrounding the former Hydro Aluminium Kurri Kurri aluminium smelter site is highly modified and vegetation exists in different condition states ranging from intact, to regrowth (with no canopy) and low maintained vegetation within power easements (ground layer vegetation only). Two plant community types (PCTs) were identified in the Proposal Site (Table 7.1):

- Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area (PCT 1633)
- Typha rushland (PCT 1737).

Four vegetation zones representing the two PCTs were identified in the Proposal Site. An additional PCT 1740 Tall Spike Rush Freshwater Wetland occurs across the storage ponds, located adjacent to the Proposal Site to the north east. This community is within a small section of the 10 m APZ buffer around the Proposal Site. Although the vegetation zone does fall within the 10 m buffer as part of the APZ, there would be no direct impacts required for bush fire protection as this is an existing wetland. The remaining areas of the Proposal Site are cleared with existing infrastructure or comprise exotic / non-native vegetation.

One TEC listed under the BC Act occurs within the Proposal Site and surrounding landscape, namely Kurri Sand Swamp Woodland in the Sydney Basin Bioregion (Endangered Ecological Community). The Kurri Sand Swamp Woodland in the Sydney Basin Bioregion corresponds to the Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area community (PCT 1633). This community occurs within the Kurri Kurri - Cessnock area in the lower Hunter Valley, in the local government area of Cessnock, but may also occur elsewhere (OEH 2016a).

Importantly, as the Typha rushland community (PCT 1737) only occurs in man-made channels and drainage structures within the Proposal Site, it is considered inconsistent with the Threatened Ecological Community - Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (Endangered BC Act). This vegetation is not listed as a TEC under the EPBC Act.

Table 7.1: Plant community types, vegetation zones and threatened ecological communities identified in the Proposal Site footprint and adjacent APZ

Vegetation zone	Plant community type ID No.	Plant community type name	Corresponding Threatened ecological community (TEC)	Broad condition class	Vegetation zone area (ha) Proposal Site including APZ Total
1	1633	Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area	Kurri Sand Swamp Woodland in the Sydney Basin Bioregion (Endangered, BC Act)	Intact	0.40 ha
2	1633	Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area	Kurri Sand Swamp Woodland in the Sydney Basin Bioregion (Endangered, BC Act)	Regrowth	0.21 ha
3	1633	Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area	Kurri Sand Swamp Woodland in the Sydney Basin Bioregion (Endangered, BC Act)	Ground layer only	0.88 ha
4	1737	Typha rushland	-	Moderate	0.05 ha
TOTAL					**1.54 ha**

Candidate threatened flora species

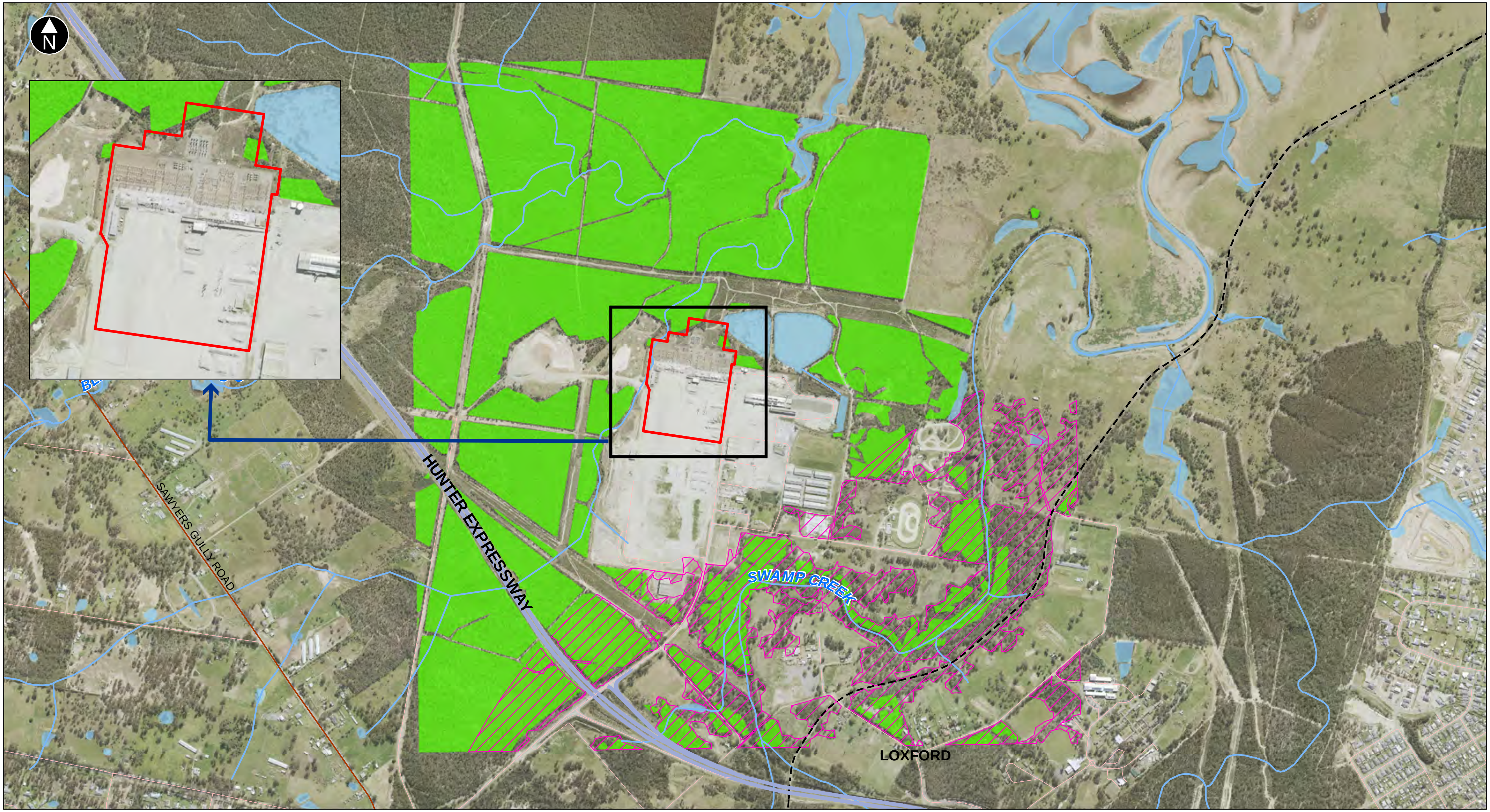
Twelve candidate threatened plant species (species credits) were identified as having potential habitat within the study area by the Biodiversity Assessment Method Calculator (BAM-C) and a review of databases and these species were targeted by survey. One of the target threatened plant species was found within or adjacent to the Proposal Site, namely *Eucalyptus parramattensis subsp. decadens* (Vulnerable, EPBC Act and Vulnerable BC Act).

7.2.2 Threatened fauna species

Candidate fauna species added to the assessment

The following list of threatened species-credit species were not identified by the BAM-C, though are considered to have a moderate potential of occurring within the study area based on suitable habitat and/or database records of recorded sightings:

- The Regent Honeyeater (*Anthochaera phrygia*) (Critically Endangered, EPBC Act and BC Act) was not identified by the BAM-C as being associated with the PCTs within the study area. The Regent Honeyeater is a dual credit species (a species considered both an ecosystem credit and species-credit species), with the species-credit component represented by mapped Important Areas. A map of important habitat has been prepared for this species under the provisions of the BAM and extends over a portion of the intact forest habitat within the study area, which includes PCT 1633 Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark shrubby intact woodland (part of Vegetation Zone 1) (refer to Figure 7.3).



Proposal site
Regent Honeyeater habitat
Swift Parrot habitat
Motorway
Main roads
Roads
Railway
Waterbodies

0 0.5 1 km

1:20,000 at A4

GDA 1994 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

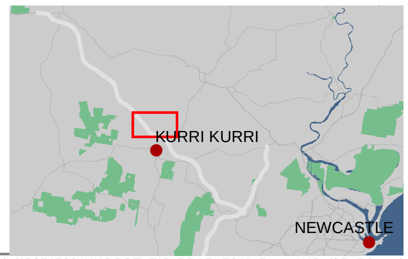


Figure 7-3 Regent Honeyeater and Swift Parrot important areas map

According to the BAM, for dual credit species part of the habitat is assessed as a species-credit (e.g. breeding habitat or land mapped on an important habitat map for a species). In the case of the Regent Honeyeater, the important habitat map covers vegetation within the Proposal Site and study area. Therefore, a survey is not required for the Regent Honeyeater and the species is assumed present. The species polygon is determined based on the entire area of important habitat that intersects the suitable vegetation in the Proposal Site.

For flora species, while parts of the Proposal Site comprise regrowth and cleared and maintained areas, these are all different condition states for the PCT 1633, and as such, threatened flora species that can be associated with this vegetation type as well as the Typha sedgeland community have been included. The list of candidate species assessed in detail is shown in Table 7.2.

Candidate threatened fauna species

Eleven candidate threatened fauna species (species credits) were identified as having potential habitat on the Proposal Site by the BAM-C. One species was positively identified, the Southern Myotis (*Myotis macropus*), and a further species, the Common Planigale (*Planigale maculata*) was assumed present based on the presence of suitable habitat, and the capture of the Yellow-footed Antechinus (*Antechinus flavipes*), which is typically associated with the same habitats.

The Regent Honeyeater and Swift Parrot (*Lathamus discolor*) were not identified from surveys within the study area, however both species are known to frequent the Kurri and Cessnock area (Birds Australia, 2013), and the 'Important Area Maps' for both species maps important habitat within the landscape buffer surrounding the Proposal Site (Figure 7.3). The Regent Honeyeater and Swift Parrot are identified in the Threatened Biodiversity Data Collection as potentially subject to serious and irreversible impacts (SAII) in relation to impacts on breeding habitat. The threshold identified is 'mapped Important Areas'. The Important Area habitat mapped for the Swift Parrot does not overlay the Proposal Site. However, the intact area of PCT 1633 (0.40 ha) within the Proposal Site and APZ boundary does intersect the important habitat mapped for the Regent Honeyeater across the broader Kurri Kurri and Cessnock area.

Based on available literature and current knowledge of habitat preferences for the Regent Honeyeater in the Hunter Valley, the habitat within the study area would not be considered important, despite overlaying a portion of the important habitat mapping, as it contains no key foraging species, with exception of low numbers of Stringybark. Therefore, there are no significant impacts predicted to foraging habitat for the Regent Honeyeater as a result of the minor clearing required for the Proposal.

7.2.3 Candidate species for further assessment

The list of species identified for further assessment is shown below in Table 7.2.

Table 7.2: Summary of candidate species for further assessment

Species name	Common name	EPBC Act	BC Act	Sensitivity to gain class	SAII[1]	Relevant habitat in the study area
Plants						
Acacia bynoeana	Bynoe's Wattle	V	E	High	No	Highest quality habitat represented by the intact patches of PCT 1633, located to the east and west of the Proposal Site.
Asperula asthenes	Trailing Woodruff	V	V	High	No	
Callistemon linearifolius	Netted Bottle Brush	-	V	Moderate	No	
Cryptostylis hunteriana	Leafless Tongue-orchid	V	v	Moderate	No	
Eucalyptus glaucina	Slaty Red Gum	V	V	High	No	

Species name	Common name	EPBC Act	BC Act	Sensitivity to gain class	SAII[1]	Relevant habitat in the study area
Eucalyptus parramattensis subsp. decadens	Earp's Gum	V	V	High	No	
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	High	No	
Melaeuca biconvexa	Biconvex Paperbark	-	V	High	No	Marginal habitat located within the Typha sedgeland (PCT 1737), this habitat is ephemeral and man-made, therefore likelihood is low; however, these species were targeted to confirm if they were present.
Maundia triglochinoides	Maundia	-	V	High	No	
Pericaria elatior	Tall Knotweed	V	V	High	No	
Rutidosis heterogama	Heath Wrinklewort	V	V	High	No	
Zannichellia palutris	Zannichelia	-	E	High	No	
Fauna						
Burhinus grallarius	Bush Stone Curlew	-	E	High	No	Potential habitat is associated with the intact patches of PCT 1633, located to the east and west of the Proposal Site
Cercartetus nanus	Eastern Pygmy-possum	-	V	High	No	
Petaurus norfolcensis	Squirrel Glider	-	V	High	No	
Phascolarctos cinereus	Koala	V	V	High	No	
Planigale maculata	Common Planigale	-	V	High	No	
Hoplocephalus bitorquatus	Pale-headed Snake	-	V	High	No	
Myotis macropus	Southern Myotis	-	V	High	No	Potential habitat is associated vegetation within 200 m of the storage ponds and the creek line to the west of the Proposal Site
Litoria aurea	Green and Golden Bell Frog	V	E	High	No	Potential habitat within the Proposal Site is associated with the ephemeral Typha sedgelands (PCT1737) and low-lying areas of PCT1633 subject to ponding/inundation of surface water
Litoria brevipalmata	Green-thighed Frog	-	V	High	No	
Crinia tinnula	Wallum Froglet	-	V	High	No	
Uperoleia mahonyi	Mahony's Toadlet	-	V	High	No	

Note:

1. SAII: The concept of serious and irreversible impacts (SAII) is fundamentally about protecting threatened entities that are most at risk of extinction from potential development.

7.2.4 Groundwater dependent ecosystems

The Atlas of GDEs (Bureau of Meteorology, 2020) does not identify any GDEs on the actual Proposal Site, however, identifies the surrounding vegetation as containing at least four moderate to high potential terrestrial GDE vegetation types. A comparison of the Atlas of GDEs dataset with the vegetation mapping in VIZ_183 identifies these as:

- Parramatta Red Gum/Narrow-leaved Apple/Prickly-leaved Paperbark shrubby woodland in the Cessnock Kurri Kurri area
- Cabbage Gum/Rough-barked Apple grassy woodland on alluvial floodplains of the lower Hunter
- Spotted Gum - Broad-leaved Ironbark Grassy Open Forest of Dry Hills of the lower Hunter Valley, Sydney Basin
- Forest Red Gum-Grey Gum Dry Open Forest on Hills of the Lower Hunter Valley, Sydney Basin.

7.2.5 Aquatic ecology

The Proposal Site is on the fringe of the Hunter River floodplain. There are no named or unnamed watercourses that intersect the boundaries of the Proposal Site. Named watercourses in the landscape buffer include:

- Black Waterholes Creek, located immediately to the west of the Proposal Site and which flows from south to north
- Swamp Creek, 900 m to the east of the Proposal Site, which flows in a northward direction
- Both Black Waterholes Creek and Swamp Creek drain to Wentworth Swamp about 1.5 km north of the Proposal Site, which drains to the Hunter River at Maitland.

The Southern Purple Spotted Gudgeon (*Mogurnda adspersa*), which is listed as endangered under *Fisheries management Act 1994* is mapped as having potential habitat in Swamp Creek and Black Waterholes Creek (DPI, 2016). There are no Coastal wetlands as defined by the Coastal Management SEPP close to the Proposal Site, the closest being the Hunter Estuary Wetland, located approximately 45 km downstream.

The 1,500 m landscape buffer also includes Swamp Creek, which is a perennial, fourth order stream (Strahler, 1952) and flows in a north easterly direction, approximately 950 m east of the Proposal Site, and some unnamed tributaries.

There is no mapped threatened fish habitat within the Proposal site. However, both Black Waterholes Creek and Swamp Creek are listed as freshwater Key Fish Habitat (DPI, 2007). The Fisheries NSW Spatial Data Portal lists the status of Swamp Creek as fair fish habitat. Threatened fish indicative habitat mapping (DPI, 2020) shows potential habitat for this species occurring within the disturbance area for the Purple Spotted Gudgeon (endangered population under the *Fisheries Management Act 1994*) (DPI, 2016).

7.3 Impact assessment

The potential for direct impacts to biodiversity is limited to clearing of native vegetation and habitat. The Proposal would not impact any areas of land that the Minister for Energy and Environment has declared as an area of outstanding biodiversity value in accordance with Section 3.1 of the BC Act. The potential impacts of the Proposal were assessed against the relevant matters in the Biodiversity Assessment Method, including:

- Removal of native vegetation and habitat, including direct and indirect impacts on native vegetation and threatened flora
- The potential for serious and irreversible impacts on identified threatened species and ecological communities
- The prescribed biodiversity impacts under the Biodiversity Assessment Method
- The potential for impacts on relevant MNES under the EPBC Act.

A key aspect of this Proposal is the degree of avoidance of impacts to native vegetation. The Proposal is planned to be constructed on the former Hydro Aluminium Kurri Kurri aluminium smelter site, with 88 per cent of the Proposal footprint located on cleared land interspersed with patches of lawn / exotic grass and weeds. Of the remaining 12 per cent (1.54 ha), nearly two-thirds of this land (1.14 ha) comprises regrowth and ground layer vegetation on formerly cleared or maintained power easements and historic fire protection zones.

7.3.1 Direct impacts on native vegetation

Despite avoidance and minimisation measures, the Proposal would result in the direct removal of some native vegetation. The estimated native vegetation clearing is approximately 1.54 ha consisting of the following PCTs:

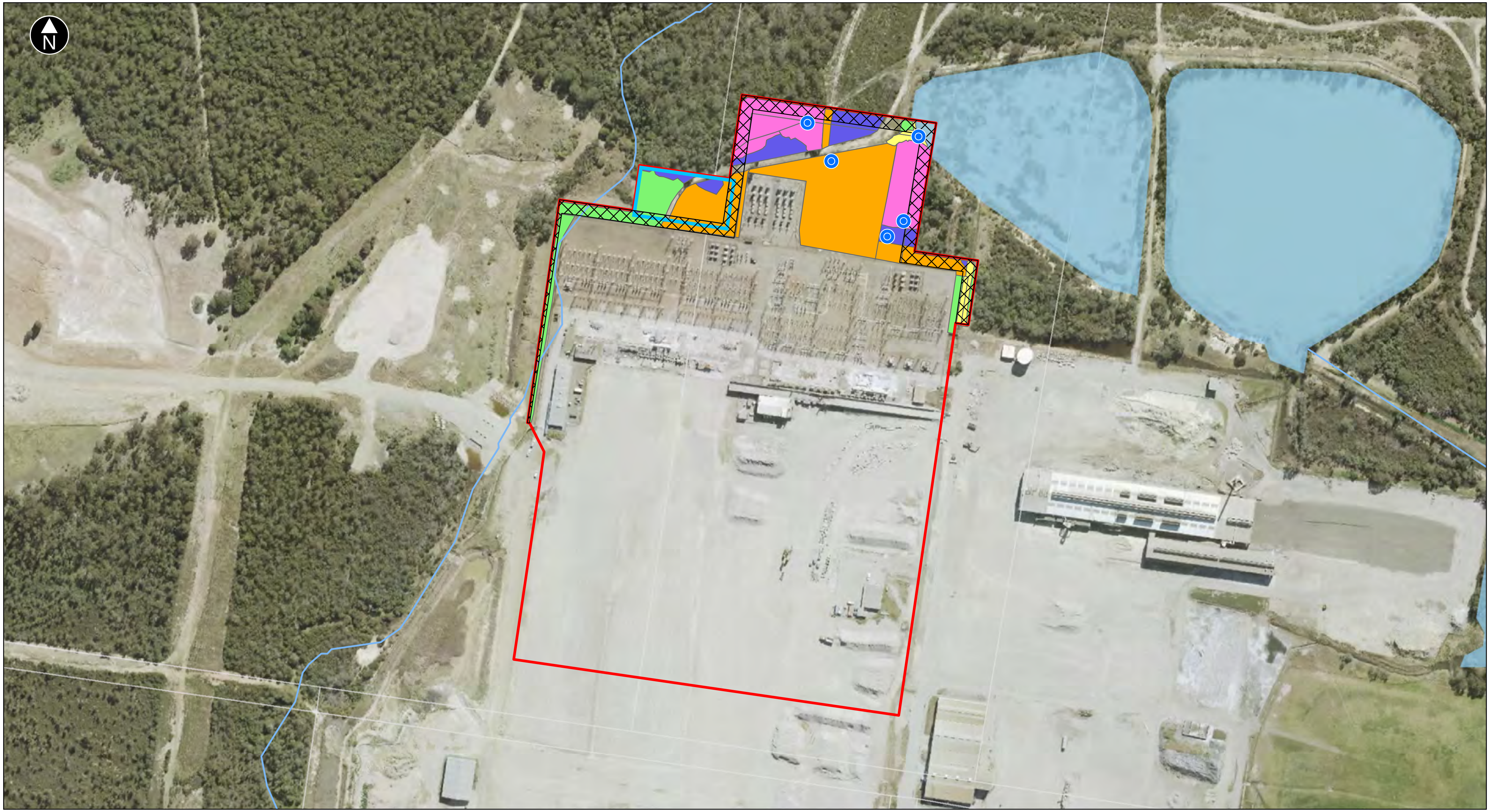
- Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area (PCT 1633) – 1.49 ha
- Typha rushland (PCT 1737) – 0.05 ha.

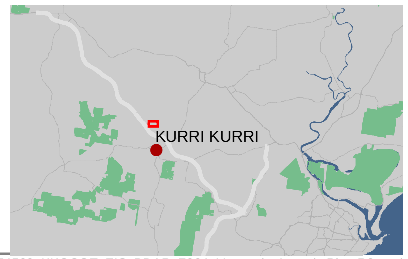
One Threatened Ecological Community (TEC) listed under the BC Act would be impacted by the Proposal:

- Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area (PCT 1633) – 1.49 ha.

Around 1.09 ha of PCT1633 that is within the Proposal Site occurs within an existing power easement and APZ where vegetation is regularly maintained. Accordingly, this vegetation is mapped as ‘regrowth’ or ‘ground layer’ only, to differentiate it from the ‘intact’ areas of this PCT. The intact vegetation, outside the power easement, comprises the remaining 0.40 ha. The mapped vegetation within the Proposal Site that would be impacted by the Proposal is shown in Figure 7.4.

Table 7.3 provides a summary of the native vegetation clearing that would occur within the Proposal Site, APZ and stormwater basin boundary including the corresponding BC Act TEC (where applicable), and the vegetation integrity loss. There were three vegetation zones of PCT 1633 identified within the Proposal Site all containing different conditions classes: Vegetation Zone 1 – intact; Vegetation Zone 2 – regrowth; and Vegetation Zone 3 – ground layer. The vegetation zones pertaining to PCT 1633 have been calculated separately, based on their condition class. Vegetation clearing as part of this proposal would directly impact a Threatened Ecological Community (TEC) listed under the BC Act. No direct impacts would occur to TECs listed under the EPBC Act.





Proposal site
Vegetation integrity plots
Asset protection zone
Detention basin
Waterbodies

Plant community type and vegetation zones

PCT 1633: Parramatta Red Gum - Narrow-leaved Apple - Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area, Intact (Zone 1)

PCT 1633: Parramatta Red Gum - Narrow-leaved Apple - Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area, Regrowth (Zone 2)

PCT 1633: Parramatta Red Gum - Narrow-leaved Apple - Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area, Groundlayer only (Zone 3)

PCT 1737: Typha rushland, Moderate (Zone 4)

Other, Exotic (non-native vegetation)

1:4,000 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 7-4 Plant community types and vegetation zones

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Created by : AA | QA by : KI

snowy hydro renewable energy Jacobs

Table 7.3: Summary of native vegetation clearing within the Proposal Site

Vegetation Zone	Plant community type / Zone	Plant community type name	Vegetation formation	PCT per cent cleared (historically across range)	Corresponding Threatened Ecological Community (TEC) BC Act	Area (ha) in Proposal Site	Vegetation integrity loss
1	1633 Intact	Parramatta Red Gum - Narrow-leaved Apple - Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area – Intact	Dry Sclerophyll Forests (Shrubby sub-formation)	75%	Kurri Sand Swamp Woodland in the Sydney Basin Bioregion	0.40 ha	46.5
2	1633 Regrowth	Parramatta Red Gum - Narrow-leaved Apple - Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area – Regrowth	Dry Sclerophyll Forests (Shrubby sub-formation)	75%	Kurri Sand Swamp Woodland in the Sydney Basin Bioregion	0.21 ha	35.5
3	1633 Ground layer only	Parramatta Red Gum - Narrow-leaved Apple - Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area – Ground layer only	Dry Sclerophyll Forests (Shrubby sub-formation)	75%	Kurri Sand Swamp Woodland in the Sydney Basin Bioregion	0.88 ha	1.5

Vegetation Zone	Plant community type / Zone	Plant community type name	Vegetation formation	PCT per cent cleared (historically across range)	Corresponding Threatened Ecological Community (TEC) BC Act	Area (ha) in Proposal Site	Vegetation integrity loss
4	1737 Moderate	Typha rushland - Moderate	Freshwater Wetlands	70%	Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	0.13 ha	4.9
					Total	**1.54 ha**	**-**

Vegetation integrity is a relative score comparing the vegetation at a site with the 'best-on-offer' condition for that PCT in NSW. It represents the degree to which the composition, structure and function of the vegetation type at a site differs from a benchmark representing the mean of the best-on-offer condition plots for that PCT in NSW. Best-on-offer sites are those sites within the contemporary landscape with higher numbers of native plant species, greater structural complexity and replete with functional components, relative to other sites within the same vegetation type and bioregion. Hence, from Table 7.3 it can be seen that the clearing of 'intact' vegetation in PCT 1633 results in a greater vegetation integrity loss (46.5) than for the clearing of a larger area of 'ground layer' vegetation in the same PCT (1.5).

7.3.2 Threatened species and habitat

The direct impacts on threatened species habitat associated with the clearing of native vegetation are outlined in Table 7.4.

For the threatened plant species, *Eucalyptus parramattensis subsp. decadens*, a direct count of individuals located within the Proposal Site was made to quantify the impact of the Proposal for the species. This search and count focused on the area of the Proposal Site, the 10 m wide buffer (APZ) and the stormwater basin, where this intersected with native vegetation and habitat for the species.

For threatened fauna, the area of habitat (species polygon) associated with the species was calculated. For Southern Myotis, this included the area of native vegetation within a 200 m buffer around the storage ponds.

For the Common Planigale, the species polygon included the area of intact woodland associated with Vegetation Zone 1 of PCT 1633. This habitat contains microhabitat features considered important for this species, including woody debris, tall groundcover vegetation, and structural complexity including shrubs, and trees. In contrast, the regrowth and ground layer vegetation has been previously cleared, and there is no remaining woody debris, and very simple structural complexity. This habitat is not expected to be preferred by this small mammal species due to the lack of shelter and cover.

For the Regent Honeyeater, the species polygon included the area of intact habitat associated with PCT 1633, which was quantified by overlaying the area of vegetation captured within the species 'Important Areas' habitat map referred to in Section 7.4. The TBDC identifies that this species requires assessment as a dual credit species. This is relevant for the Proposal Site because part of the habitat being directly impacted is within the Important

Areas Map for the Regent Honeyeater. This portion of the Proposal Site includes the intact areas of vegetation mapped as Vegetation Zone 1 of PCT 1633 and that would require offset by species credits (i.e. 0.40 ha). The remaining part of the Proposal Site that is not within the Important Area mapping can be offset by ecosystem credits (e.g. foraging habitat, unmapped locations used by a species). On the basis that the Important Area Map intersects the intact habitat on the Proposal Site, the species is assumed present.

The Swift Parrot is not assumed to be present, on the basis that the important habitat mapping does not intersect vegetation within the Proposal Site and that the habitat present is not preferred or important foraging habitat for this species. As the Swift Parrot breeds in Tasmania, there is no breeding habitat present.

Table 7.4: Summary of direct impacts on threatened species-credit species habitat associated with the loss of native vegetation

Species name	Common name	EPBC Act	BC Act	Sensitivity to gain class	SAII candidate	Area (ha) in Proposal Site or direct count
Eucalyptus parramattensis subsp. decadens	Earps Gum	V	V	High	No	37 plants
Myotis macropus	Southern Myotis	-	V	High	No	0.40 ha
Anthochaera phrygia	Regent Honeyeater	CE	CE	High	Yes	0.40 ha
Planogale maculata	Common Planigale	-	V	High	No	0.40 ha

7.3.3 Serious and Irreversible impacts (SAII)

The Swift Parrot and Regent Honeyeater are identified as candidate species for serious and irreversible impacts (SAII) as per Section 9.1 of the BAM. A detailed assessment was conducted for both species that addressed the criteria in Section 9.1.2 of the BAM. The assessment is provided in Appendix G of the BDAR (see Appendix B of this EIS) and concluded that the Proposal was unlikely to result in a significant impact on either species.

7.3.4 Indirect impacts

Section 2.4.1 of the BAM Stage 2 Manual defines indirect impacts. For this Proposal, they include edge effects, noise and vibration impacts, dust pollution, light pollution, contaminant pollution and the hot exhaust plume. None of these are considered to have more than a localised impact on flora and fauna.

7.3.5 Prescribed biodiversity impacts

Table 7.5 identifies the potential prescribed biodiversity impacts on threatened species associated with the Proposal in accordance with Section 8.3 of the BAM. These are impacts that are in addition to, or instead of, impacts from clearing vegetation and/or loss of habitat.

Table 7.5: Assessment of prescribed biodiversity impacts

Criteria	Assessment
Karst, caves, crevices, cliffs and other features of geological significance	There are no occurrences of karst, caves, crevices and cliffs or other geological features of significance within the Proposal Site or threatened species or ecological communities associated with these features.

Criteria	Assessment
Human made structures or non-native vegetation	There are three threatened fauna species identified at the Proposal Site that are known to use human made structures as habitat for roosting and breeding: ▪ Large Bent-winged Bat (*Miniopterus orianae oceanensis*) ▪ Little Bent-winged Bat (*Miniopterus australis*) ▪ Southern Myotis (*Myotis macropus*). The cave roosting bats are known to roost in cave-like human made structures including mine shafts, storm water channels, large culverts, buildings, and under bridges. There are no human made structures in the Proposal Site that would be suitable for these bats to use as roosting habitat. There are small areas of planted shrubs within the former smelter infrastructure areas, as well as exotic (non-native vegetation) in previously cleared areas of site. The habitat value for these features is considered very low. Invasive weed species (including high threat weeds) were noted in the edges of the intact forest and regrowth forest and along cleared tracks and land, although rarely within the intact forest. Future weed invasion into adjoining habitats is possible, although based on observation with the intact areas of forest, is predicted to be low.
Habitat connectivity	Habitat connectivity is identified as the degree to which a particular site connects different areas of habitat of threatened species to facilitate the movement of those species across their range. Threatened species movement is identified as the degree to which a particular site contributes to the movement of threatened species to maintain their lifecycle. In terms of habitat connectivity, the Proposal Site is located mainly within a highly disturbed and previously cleared landscape where the majority of habitats have been cleared. The habitat that is proposed to be impacted is on the edge of the Proposal Site and does not involve fragmenting habitat or any fauna corridors. The proposed habitat removal would be considered a small amount on the edge of a large patch. This would not contribute further to fragmentation. Threatened species known from the locality, including the Grey-headed Flying-fox, Swift Parrot, Regent Honeyeater and Southern Myotis (and other threatened bats) are powerful flyers capable of covering large distances between habitat patches. The landscape of the locality in its current form is permeable to these species and habitat connectivity for these species would not be detrimentally affected, and the bioregional persistence of these species would not be detrimentally affected by the Proposal.

7.3.6 Groundwater dependent ecosystems

Based on the review and data collected during field surveys undertaken for this assessment, there is potential for groundwater dependent terrestrial vegetation types to be present and impacted, particularly PCT 1633 – Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area. The PCTs 1737 and 1740 both occur in constructed artificial drainage structures and are unlikely to be GDEs, having no connection to groundwater.

Using the *Risk Assessment Guidelines for Groundwater Dependant Ecosystems* released by the NSW DPI (Kuginis et al., 2012), it is unlikely that the PCTs in the Proposal Site have a total reliance on groundwater. PCT 1633 is the only potential GDE in the Proposal Site. This community is likely to be a proportional facultative GDE that depends on the subsurface presence of groundwater (often accessed via the capillary fringe, subsurface water just above the water table) for a proportion of their water requirements, particularly where an alternative source of water (i.e. rainfall) cannot be relied on to maintain ecological function. These GDEs may use groundwater during periods of low flow or drought. The level of groundwater dependency would also likely change between the PCTs in different areas, depending on the groundwater level at any given time. The groundwater impact assessment (see Chapter 12) does not predict any measurable changes in groundwater levels or flows beyond the Proposal Site, and therefore impacts to GDE are not predicted.

7.3.7 Aquatic ecology

Appendix I and Chapter 13 describe potential impacts on aquatic ecology in detail and conclude that the Proposal is unlikely to result in a significant impact as no channel works are proposed and as no significant impacts to water quality or hydrology are predicted.

7.4 Mitigation measures

Once all practicable steps to avoid or minimise impacts have been implemented during the detailed design phase of the Proposal, mitigation measures would be implemented during construction to further lessen the potential ecological impacts of the Proposal.

Biodiversity impacts during construction would be mitigated in accordance with a Construction Environmental Management Plan (CEMP), which includes the preparation and implementation of a Flora and Fauna Management Plan. Mitigation measures in the management plan are outlined in Table 7.6.

Table 7.6: Biodiversity mitigation measures

Reference	Mitigation measure	Timing
B1	The Construction Environmental Management Plan for the Proposal will include procedures for the demarcation and protection of retained vegetation, including all vegetation outside and adjacent to the construction footprint.	Construction
B2	A pre-clearing inspection will be conducted by a suitably qualified ecologist to confirm the demarcation of limits of clearing are in place, and procedures for the clearing of vegetation and the relocation of flora and fauna.	Construction
B3	A post clearance report, including any relevant Geographical Information System files, will be produced that validates the area of vegetation cleared.	Construction
B4	The Construction Environmental Management Plan for the Proposal will include weed management and control measures in accordance with the *Biosecurity Act 2015*.	Construction
B5	The Construction Environmental Management Plan for the Proposal will include pathogen management measures to prevent introduction and spread of amphibian chytrid fungus, *Phytophthora cinnamomi* and Exotic Rust Fungi.	Construction

7.5 Biodiversity offsets

The Biodiversity Offsets Scheme (BOS) is a framework to avoid, minimise and offset impacts on biodiversity from development and clearing, and to ensure land that is used to offset impacts is secured in-perpetuity. Biodiversity credits are generated from management actions that improve biodiversity values and are used to offset the loss of biodiversity values on development sites.

7.5.1 Ecosystem and species credits

Table 7.7 provides a summary of the Ecosystem Credits required for the Proposal.

Table 7.7: Ecosystem credits required

Vegetation zone	Plant community type (PCT)	Threatened Ecological Community (TEC)	Credits
1	Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area (PCT 1633) – Intact	Kurri Sand Swamp Woodland in the Sydney Basin. This includes PCTs 1633, 1635, 1650	9
2	Parramatta Red Gum – Narrow-leaved Apple – Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area (PCT 1633) - Regrowth	Kurri Sand Swamp Woodland in the Sydney Basin. This includes PCTs 1633, 1635, 1650	4
		Total	**13**

Species credits for the Proposal are outlined below in Table 7.8.

Table 7.8: Species credits required

Species	Credits
Eucalyptus parramattensis subsp. decadens (Earps Gum)	74
Myotis macropus (Southern Myotis)	9
Anthochaera phrygia (Regent Honeyeater)	14
Planigale maculata (Common Planigale)	9

7.5.2 Biodiversity Offset Strategy

Following Proposal approval, Snowy Hydro would develop and implement a strategy for meeting the Proposal's offset credit obligation which would comprise a combination of sourcing credits from the offset credit market and payment to the Biodiversity Conservation Fund for any residual credits.

8. Aboriginal heritage

This chapter presents the results of an Aboriginal Cultural Heritage Assessment (ACHAR) and an Aboriginal Archaeological Report (AAR). The ACHAR forms Appendix C to this EIS, and the AAR is Annexure A to the ACHAR.

8.1 Assessment methodology

The protection of Aboriginal cultural heritage in NSW is governed by a set of interrelated local, state and Commonwealth legislation and planning instruments. These Acts and their relevant sections and associated regulatory documents (e.g. codes of practice, guidelines, etc.) that govern the Proposal are described in Appendix C.

8.1.1 Aboriginal community consultation

The *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010a) establishes the requirements for consultation with Aboriginal stakeholders as part of the heritage assessment process to determine potential impacts of proposed activities on Aboriginal objects and places. These requirements include four stages with associated timeframes which must be adhered to:

Stage 1 — Notification of proposal and registration of interest (14 days from date letter sent to register as registered Aboriginal stakeholders)

Stage 2 — Presentation of information about the proposal

Stage 3 — Gathering information about cultural significance (28 days for registered Aboriginal stakeholders to provide a review and feedback to consultants regarding the methodology)

Stage 4 — Review of draft cultural heritage assessment report (registered Aboriginal stakeholders have 28 days from sending of the report to make a submission).

Table 8.1 summarises the consultation process undertaken for the Proposal throughout the archaeological assessment to date and outlines the stages of consultation.

Table 8.1: Summary of consultation process

Task Name	Start	Finish
Stage 1 – Agency Letters	2 November 2020	18 November 2020
Stage 1 – Newspaper advertisements	9 November 2020	2 December 2020
Stage 1 – Proposal Notification and invitation to register supplied to potential Aboriginal stakeholders	10 November 2020	25 November 2020
Stage 1 – Supply of the list of Registered Aboriginal Parties (RAPs) to Heritage NSW and Mindaribba LALC	8 December 2020	8 December 2020
Stage 2 and 3 – RAPs review of proposal information and methodology and request for information about cultural significance	27 November 2020	4 January 2021
Stage 4 – Carry out archaeological survey and prepare a draft ACHAR	4 January 2021	15 January 2021
Stage 4 – Present the draft ACHAR to RAPs for review and comment	15 February 2021	15 March 2021

8.1.2 Aboriginal cultural values and landscapes

Input and feedback can be provided by Representative Aboriginal Parties (RAPs) at any time throughout the assessment process, and was sought at several points during the process (following procedures outlined in DECCW, 2010a), including:

- During Stage 2 – Initial presentation of information about the Proposal to RAPs
- During Stage 3 – Providing RAPs with the draft proposed cultural heritage assessment methodology. RAPs were invited to provide feedback on the proposed methodology, and to identify cultural heritage values associated with the Proposal Site
- During fieldwork
- During Stage 4 – Providing RAPs with the draft Aboriginal Cultural Heritage Assessment Report. RAPs are invited to provide feedback on the report, and any further information they wish to be included.

Discussions regarding the cultural values of the Proposal Site were undertaken on 12 January 2021 during the site meeting and survey, and subsequently during the second site survey on 11 February 2021 (refer to Appendix C).

8.1.3 Significance assessment

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

- Social values
- Historical values
- Scientific values
- Aesthetic values.

Under normal circumstances, each of these values would be assessed for Aboriginal sites in the Proposal Site, and an overall significance would be assigned based on an average across the values. As no Aboriginal sites were found within the Proposal Site this assessment was not undertaken. The potential subsurface deposits surviving within the alluvium were unable to be investigated as part of this assessment and therefore could not be assessed for significance.

Previous work in the wider region has identified that there is a potential for Aboriginal objects to be located in alluvium. Where these objects are present, their distribution is generally intermittent and sparse. If Aboriginal objects are present in the alluvium of the Proposal Site, it is expected that a similar distribution pattern would be encountered.

8.1.4 Desktop review

The aim of the archaeological desktop review was to:

- Identify any known Aboriginal heritage sites or Aboriginal cultural places with potential to be impacted by the Proposal
- Identify areas within the Proposal Site where there are likely to be previously unknown Aboriginal heritage sites with potential to be impacted by the Proposal.

The desktop assessment was designed to fulfil the requirements 1-4 of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (DECCW 2010c).

Database searches

A search of the Aboriginal Heritage Information Management System (AHIMS) was carried out on 22 October 2020. The Proposal Site and a 2.5 km buffer zone was used as the search area. The buffer zone area would not be impacted by the Proposal; rather, it is included to provide information on the archaeological context of the search area.

There are 78 previously recorded sites identified in the AHIMS search, five of which were recorded as being in close proximity to the Proposal Site (within 300 m). No sites were identified within the Proposal Site (refer to Table 8.2 and Table 8.3). The complete list of AHIMS site records is provided in Annexure A of the Aboriginal Cultural Heritage Assessment Report (Appendix C).

Table 8.2: AHIMS Search Results

Site Type	Description	Number of Sites
Isolated Find	A single stone artefact	20
Artefact Scatter	Multiple stone artefacts	54
Potential archaeological deposit (PAD)	Potential (subsurface) archaeological deposit	2
Artefact Scatter with PAD	Multiple stone artefacts visible on the surface with a potential subsurface archaeological deposit	2

Table 8.3: AHIMS Sites within 300 m of the Proposal Site

AHIMS site ID	Site Name	Site Validity	Site Type	Approx. distance from the Proposal Site
37-6-3969	Hydro-IA35-15	Valid	Artefact Scatter	250 m
37-6-3872	Hydro PAD 1	Valid	PAD	50 m
37-6-3065	Hydro-AS22-14	Valid	Artefact Scatter	150 m
37-6-3068	Hydro-AS26-14	Valid	Artefact Scatter	170 m
45-3-3387	KK04	Valid	Artefact Scatter with PAD	250 m

Predictive model

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

8.1.5 Archaeological survey

The aim of the archaeological survey was to completely assess areas of the Proposal Site where impacts are proposed and identify any archaeological objects, or areas with the potential to contain archaeological objects. On-site consultation with nominated site officers from the RAPs contributed to the development of management and mitigation recommendations.

The archaeological surveys were carried out on 12 January 2021 and 11 February 2021. The surveys were carried out on foot by a team comprising nominated site officers from the RAPs and representatives of the EIS team, including an archaeologist.

The survey investigated the Proposal Site in full, with the exception that areas assessed by field teams as having no potential for archaeological material to be present (for example because of previous impacts and ground disturbance) were not surveyed. The decision to exclude areas in this way was made in the field, through a consensus of all field team members. No sub-sampling of the site was employed.

The field survey aimed to locate Aboriginal objects and areas of potential archaeological deposit (PAD), as areas with the highest potential to contain subsurface archaeological material. The survey recorded land disturbance, survey coverage variables (ground exposure and archaeological visibility) and landform types across the Proposal Site.

8.2 Existing environment

The Proposal Site is located in an area that would have provided sufficient resources for Aboriginal people to exploit. This would have been an attractive area for people to use and occupy, due to the availability of permanent potable water, ephemeral streams and proximity to the Wentworth Swamp. Evidence of this utilisation would be expected to be identified at the Proposal Site. However, land use activities in this area since European occupation are likely to have affected this.

The Proposal Site has been heavily disturbed by past development including the former aluminium smelter, and subsequently by the demolition and remediation works currently under way. It is therefore considered unlikely that Aboriginal archaeological material would exist at the Proposal Site, other than in deep alluvium that has not been previously disturbed, or in the location of the proposed switchyard (northern extent of the Proposal Site, which has been disturbed, but to a lesser extent). Therefore, while the Proposal Site lies in proximity to nearby areas that have revealed evidence of past Aboriginal use or occupation, the Proposal Site is less likely to contain any such evidence that might be uncovered in construction of the Proposal.

8.2.1 Archaeological Assessment results

A search of the AHIMS was undertaken on 22 October 2020 covering the footprint of the Proposal Site and a 2.5 km buffer zone. Seventy-eight previously recorded sites are present near the Proposal Site (no sites were identified within the Proposal Site). All sites are artefact scatters on open ground, four of which include an area of PAD.

The archaeological survey of the Proposal Site was carried out on 12 January 2021 and 11 February 2021 (refer to Figure 8.1). On-site consultation with nominated site officers from the RAPs contributed to the development of management and mitigation recommendations, including recommendations for any further assessment. No Aboriginal archaeological sites were identified within the Proposal Site. Potential for Aboriginal archaeological deposits to survive at depth was identified.

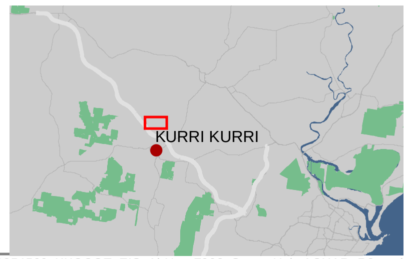
It is not possible to investigate this archaeological potential through archaeological test excavation under the Code of Practice due to the depth. As a result, the presence and extent of any Aboriginal objects at depth cannot be determined as a part of this assessment.

Proposal Site
Survey units
Motorway
Roads
Railway
Waterbodies
Cadastre

① Proposed Switchyard Area
② Proposed Plant Area
③ Proposed Buffer Area

0 250 500 m

1:10,013 at A4
Coordinate System: GDA2020 MGA Zone 56



Data sources:
Jacobs 2020
NearMap 2020
NSW Spatial Services

Figure 8-1 Aboriginal archaeological survey units

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8.2.2 Archaeological survey results

The results of the survey are provided below. No Aboriginal objects were found during the survey.

Survey unit 1: Proposed Plant and Buffer Area

Survey Unit 1 (SU1) is located within the footprint of the former aluminium smelter which has been subject to demolition and remediation. The surface comprises crushed concrete aggregate with formed drainage ditches and spoil piles (refer to Figure 8.2). There was no natural ground surface visibility and it was impossible to determine any natural landforms.

Figure 8.2: SU1 – Remediated former smelter site

Survey Unit 2: Northeast of Current Switch Yard

Survey Unit 2 (SU2) is located to the north and east of the current switchyard (part of former aluminium smelter site) and includes a drainage ditch, high voltage electricity easement and access track. Surface ground visibility is low due to grass cover and area of introduced gravel fill (Figure 8.3).

Figure 8.3: View west across survey area SU2

Survey Unit 3: North of Current Switch Yard

Survey Unit 3 (SU3) is located to the north of the smaller current switchyard (again part of former aluminium smelter site) and includes a drainage ditch, access track and remnant vegetation. Surface ground visibility is low due to grass and scrub cover (Figure 8.4).

Figure 8.4: View north west across SU3

Survey Unit 4: West of Current Switch Yard

Survey Unit 4 (SU4) is located to the west of the smaller current switchyard (again part of former aluminium smelter site) and includes a raised mound running east-west adjacent to the switchyard, a drainage ditch, access track and remnant vegetation. Surface ground visibility is low with exposures limited to the access track (Figure 8.5). The creek line is located 50 m west from the outer boundary of SU4.

Figure 8.5: View to the north at SU4

8.3 Impact assessment

The proposed works associated with the Proposal are not considered likely to have any impact on AHIMS sites as no surface Aboriginal objects were identified within the Proposal Site. However, the archaeological assessment identified the potential for subsurface deposits surviving at depth within the alluvium. This deeper alluvium may be subject to impact through excavation or foundation piling.

8.3.1 Construction

Piling works

Foundation piling works would impact only the potential deposits in the area of the piles. The surrounding material would be preserved beneath any concrete slabs and the introduced fill currently present on site. Testing to determine the nature and extent of any potential subsurface deposits could not be undertaken in accordance with the Code of Practice for the investigation of Aboriginal objects, due to the depth and the presence of the existing live high voltage electrical switchyard. It is proposed to undertake monitoring of the piling works during the construction of the Proposal according to a methodology that includes recovery of Aboriginal objects if they are identified.

Bulk excavation works

In the areas of where expected bulk excavation is to occur for the gas turbine footings and for the stormwater basin, test excavation in accordance with the Code of Practice for the investigation of Aboriginal objects is also not possible due to the depth of fill (approximately 1.5 m of the fill from the former smelter earthworks) coupled with the depth of the underlying alluvial deposits. The presence of the existing live high voltage electrical switchyard also precluded test excavation. It is proposed instead to monitor bulk excavations within undisturbed alluvium during construction of the Proposal. If Aboriginal objects are identified through monitoring, bulk excavation would cease in the immediate area while hand excavation is undertaken to assess and recover any objects.

Cumulative Impacts

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

Prior impact to large areas of land in the immediate surrounding region, and across the Hunter Valley overall, have increased the rarity of surviving Aboriginal sites in the region. However, the majority of impacts that would result from the Proposal are located within already disturbed and impacted areas and the Proposal is unlikely to further harm Aboriginal objects, if present.

As a result the cumulative impact of the Proposal would not result in a substantial reduction in the region's Aboriginal archaeological resource.

8.3.2 Operation

No impacts to Aboriginal heritage are expected during the Proposal's operation.

8.4 Mitigation measures

Potential impacts during the operation phase of the Proposal will be mitigated through implementation of measures outlined in Table 8.4: .

Table 8.4: Aboriginal heritage mitigation measures

Reference	Mitigation Measure	Timing
AH1	During site inductions for the Proposal's construction, all members of the construction workforce will undergo cultural awareness training. The training, to be coordinated by the Contractor's Environmental Manager, will incorporate material provided by the RAPs, with the specific aim of raising awareness of the cultural heritage values held by the local Aboriginal community, in respect of the Proposal Site and surrounding land.	Construction
AH2	In the areas where the deep alluvium will be impacted through piling or bulk excavation works for the Proposal, this will be monitored by an archaeologist and a representative of the Registered Aboriginal Parties (RAPs). Any Aboriginal objects uncovered during these activities will be collected and their location recorded on AHIMS, in accordance with s89a of the *National Parks and Wildlife Act 1974*. The artefact assemblage would be temporarily stored and analysed. Long term management of those objects will be determined by the RAPs.	Construction

Reference	Mitigation Measure	Timing
AH3	If skeletal remains are uncovered during the course of works, all work must stop immediately in the vicinity of the remains and the area secured, so that no further harm occurs. If it is identified that the skeletal remains are likely to be human and are likely to represent a crime scene, the NSW Police must be called in the first instance. The NSW Police will determine the appropriate course of action. If it is identified that the skeletal remains are likely to be human and are likely to represent Aboriginal ancestral remains, or human remains that would require consideration under the *Heritage Act 1977* (both Aboriginal and non-Aboriginal), both the NSW Police and Heritage NSW must be called. Heritage NSW will determine the appropriate course of action. Work may not recommence in this area until either NSW Police or Heritage NSW provide authorisation. If the remains are identified as Aboriginal, discussions and negotiations would need to occur with the relevant Aboriginal communities and Heritage NSW to determine the most appropriate course of action. These discussions would be led by Heritage NSW. If it is identified that the skeletal remains are not human, appropriate recording must take place and works can continue.	Construction

9. Non-Aboriginal heritage

This chapter addresses the heritage assessment requirements of the SEARs for the Proposal. A non-Aboriginal cultural heritage assessment report (see Appendix D) was prepared which reports the findings of the assessment. A summary of the assessment is presented in this chapter.

9.1 Assessment methodology

Given its highly disturbed nature, it is considered unlikely that there would be any items or material of heritage significance found within the Proposal Site or its immediate surrounds. Therefore, the non-Aboriginal heritage impact assessment was conducted as a desktop assessment, through searches of relevant heritage registers and databases, as well as background historical research in relation to the Proposal Site and its surrounds. No field investigations or reviews of previous archaeological reports, geology or ethno-historical accounts were undertaken.

9.2 Existing environment

9.2.1 History of the site and surrounds

The Proposal Site is part of a highly disturbed industrial landscape. Early settlement in the Kurri Kurri region occurred in the early 19th Century. Following the first non-Aboriginal settlers into the region, large portions of land to the north of the Proposal site were reserved as Village Reserve and Travelling Stock Route. Local soils were reported as unfavourable for crop farming and land was cultivated and predominantly used for beef cattle rearing and grazing (Pike and Walker and Associates 1994: 6). The greater Kurri Kurri area remained predominantly rural until the discovery of coal in commercial quantities and the subsequent development of the South Maitland Coalfields. Greta Coal and Shale Mine Company was the first commercial coal operation in the area, forming in 1864 (Parkes et al., 1979: 217; cited in Appendix C). The growth in coal resulted in population growth that eventually led to the establishment of the town of Kurri Kurri in 1902 (Smith, 1979: 4). Kurri Kurri became the first government proclaimed mining town in NSW. The local coal mining industry began declining in the 1950s and 1960s as a result of deepening seams, difficult ground conditions and a reduction in coal markets.

Following the decline in the coal mining industry, Kurri Kurri was chosen as the location for a new aluminium smelter, which commenced operations in 1969. The location was ideal to provide aluminium to the Port of Newcastle and due to its proximity to the state's major power stations. The original capacity of the smelter was less than 25,000 tonnes of aluminium per annum. Two expansion projects brought the annual tonnage to 150,000 tonnes by 1985. In mid-2000, the smelter was acquired by the German company VAW Aluminium AG under which it operated for two years before it was passed to Norsk Hydro ASA. Over time, the production of aluminium became unviable due to the increasing privatisation of the local electricity market and a weak global market for aluminium. Norsk Hydro announced the decommissioning of the smelter in 2012 and it was permanently closed in 2014.

9.2.2 Local heritage inventory

A search of heritage registers and databases was undertaken on 16 December 2020. The searches included:

- The Australian Heritage Database (AHD), which includes Australian World Heritage Areas, National Heritage List and Commonwealth Heritage List
- Register of the National Estate
- NSW State Heritage Register
- Cessnock Local Environmental Plan 2011 (Cessnock LEP)
- Transport for NSW s170 heritage register.

The database search found no registered items to be located within a 1 km radius of the Proposal Site. One item of local significance was found approximately 1.3 km east of the Proposal Site. Table 9.1 lists the known heritage items in close proximity to the Proposal Site while Figure 9.1 shows the location of the registered item.

Table 9.1: Listed historical heritage items in the vicinity of the Proposal Site

Heritage register	Item name	Address of item type	ID number (Map reference)	Distance to project area	Potential to be Impacted (Y/N)
Cessnock LEP	South Maitland Railway System	Between Pelton Colliery Triangle and LGA Boundary at Cliftleigh, NSW	I212	1.3 km	N

A Statement of Heritage Impact undertaken by RPS (RPS, 2015), assessed the smelter complex to have local significance. However, its retention as a heritage item was not considered viable and approval was subsequently given for its staged demolition which is now almost complete.

Proposal site

Motorway

Main roads

Roads

Railway

Waterbodies

EPI Heritage (Cessnock Local Environmental Plan 2011)

1 Proposed Switchyard Area

2 Proposed Plant Area

3 Proposed Buffer Area

0 0.5 1 km

1:15,000 at A4

Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs 2020
Aerometrix 2020
NSW Spatial Services
NSW environmental planning instrument (EPI)

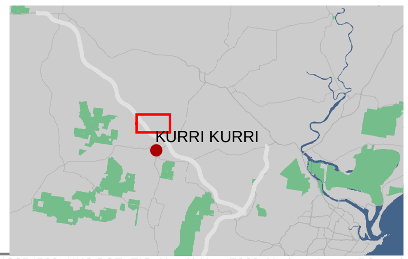


Figure 9-1 Location of historical heritage items in the vicinity of the Proposal Site

9.3 Assessment of impacts

9.3.1 Construction

No known or listed non-Aboriginal heritage items have been identified within or in close proximity to the Proposal Site. The construction of the Proposal is therefore unlikely to impact any non-Aboriginal heritage items within or nearby the Proposal Site. During construction, any unexpected finds of items or material with potential non-Aboriginal archaeological or historic significance, would require further assessment (see Section 9.4).

9.3.2 Operation

The operation of the Proposal would not result in any impacts to non-Aboriginal heritage objects, sites, or potential archaeological deposits within or nearby the Proposal Site.

9.4 Mitigation measures

The assessment indicated that there were no non-Aboriginal heritage items within the Proposal Site or in close proximity. The Proposal would have no direct impact or visual impact on any nearby heritage items.

During construction, the following measures outlined in Table 9.2, will be implemented to ensure protection of any items, sites or deposits of material with potential non-Aboriginal heritage significance that may be uncovered during the works:

Table 9.2: Non-Aboriginal heritage mitigation measures

Reference	Mitigation Measure	Timing
NAH1	All contractors and subcontractors will be made aware of their obligations under the *Heritage Act 1977*.	Construction
NAH2	Should any unexpected non-Aboriginal heritage items be uncovered and identified during the proposed works, works will cease, and the project area be cordoned off. A qualified archaeologist and, if necessary, Heritage NSW (in accordance with s146 of the *Heritage Act 1977*) would be contacted to assess significance and advise on further requirements before work can recommence.	Construction

10. Hazards and risk

The SEARs require the EIS to analyse aspects of the Proposal which may impose a public risk. This chapter comprises four subsections namely:

- Preliminary Hazard Analysis
- Bushfire risk
- Plume rise and aviation risk
- Electric and magnetic fields.

10.1 Preliminary hazard analysis

10.1.1 Assessment methodology

The Preliminary Hazard Analysis (PHA) follows the requirements of the Hazardous Industry Planning Advisory Paper No. 6 – Guidelines of Hazard Analysis (NSW, 2011) and Multi-level Risk Assessment (NSW, 2011) and demonstrates that the risks from the Proposal comply with the criteria of Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning (NSW, 2011).

A review of relevant information and a Hazard and Risk Workshop were held to identify hazards associated with the Proposal. Risks associated with these hazards were then considered in the context of land use safety criteria based on guidance from State Environmental Planning Policy No.33 (SEPP 33) Hazardous and Offensive Development and applicable Hazardous Industry Planning Advisory Papers (HIPAP).

Hazardous Industry Planning Advisory Paper No 4 – Risk Criteria for Land Use Safety Planning (NSW, 2011) provides risk criteria to evaluate the physical magnitude of a given risk and community concerns over risks that are imposed rather than voluntarily accepted. Risk criterion consider:

- Individual risk, which considers the acceptability of a particular level of risk to an exposed individual
- Societal risk, which takes into account society's aversion to accidents which can result in multiple fatalities.

State Environmental Planning Policy 33 (SEPP 33) – Hazardous and Offensive Development (1992) refers to two land use groupings:

- Sensitive land use (including residential, hospitals and schools)
- Other land use (including rural, commercial and industrial).

10.1.2 Existing environment

There are no sensitive (or residential) land uses proximate to the Proposal Site. The closest residential zoned land is the suburban areas of Kurri Kurri, located approximately 2.5 km south and south-west of the Proposal Site. Further residential areas at Heddon Greta and Cliftleigh are situated approximately 2.9 km to the east. There are some sparse rural residential properties south and south-east of the Proposal Site, the nearest being located on Dawes Avenue, Loxford which is approximately 1.15 km south-east of the Proposal Site.

Three populations external to the Proposal Site are considered for risk analysis purposes:

- Industrial Estate occupants, at < 0.2 km distance (assuming proposed rezoning of land as per ReGrowth Kurri Kurri)
- Rural Residential occupants, at approximately 1.15 km distance
- General/Low Density Residential, at > 2.5 km distance.

The gas receiving station (GRS) will be a third party's asset and responsibility and the risks associated with the GRS will be included as a component of the gas lateral pipeline assessment (to be completed by a third party). However, functionally the GRS would be situated within the Proposal Site and therefore could affect the cumulative risk profile of the Proposal Site. For this reason, the risks associated with the GRS have been considered in the context of the Proposal's PHA.

10.1.3 Impact Assessment

The Proposal will exceed the NSW *Environmental Planning and Assessment Regulation 2000* Schedule 3 definition of designated development for electricity generating stations (30 MW) and is therefore deemed as a potentially offensive industry development.

In accordance with the SEARs assessment method, the Proposal is assessed to be a potential hazardous industry based on the volume of dangerous goods / hazardous chemical proposed to be stored within the Proposal Site. This determination is attributed to the volume of approximately 1,300 kg of natural gas fuel inherently stored within the site (power station pipework and equipment as well as GRS) exceeding the threshold based on ADGC Class 2.1 dangerous goods (natural gas) quantity stored. The threshold does not apply to the storage of Class C1 (diesel) fuel. Similarly, the assessment threshold for transportation by vehicle movements of dangerous goods is not exceeded for Class C1 (diesel) and/or Class 9 (miscellaneous chemicals) goods.

Figure 10.1 shows the heat radiation effects for various volumes of gas. For the approximate 1,300 kg of pressurised natural gas held on the Proposal Site, it can be seen that sensitive receptors should be at least 50 m away. As the nearest sensitive receptors are rural residential properties on Dawes Avenue and Bowditch Road at Loxford at approximately 1.15 km to the south-east of the Proposal Site, no sensitive receptors are predicted to be impacted by heat radiation effects.

The minimum distance to other land uses of 35 m is met for future neighbouring industrial land use both to the east and south of the Proposal Site. However, the minimum distance of the Proposal Site boundary towards the west is not met. This land is proposed to be zoned as Industrial and Rural Landscape and is likely to comprise an access road to the Hydro Aluminium remediation contamination containment cell, stormwater ponds for the proposed industrial estate, a creek and bushland.

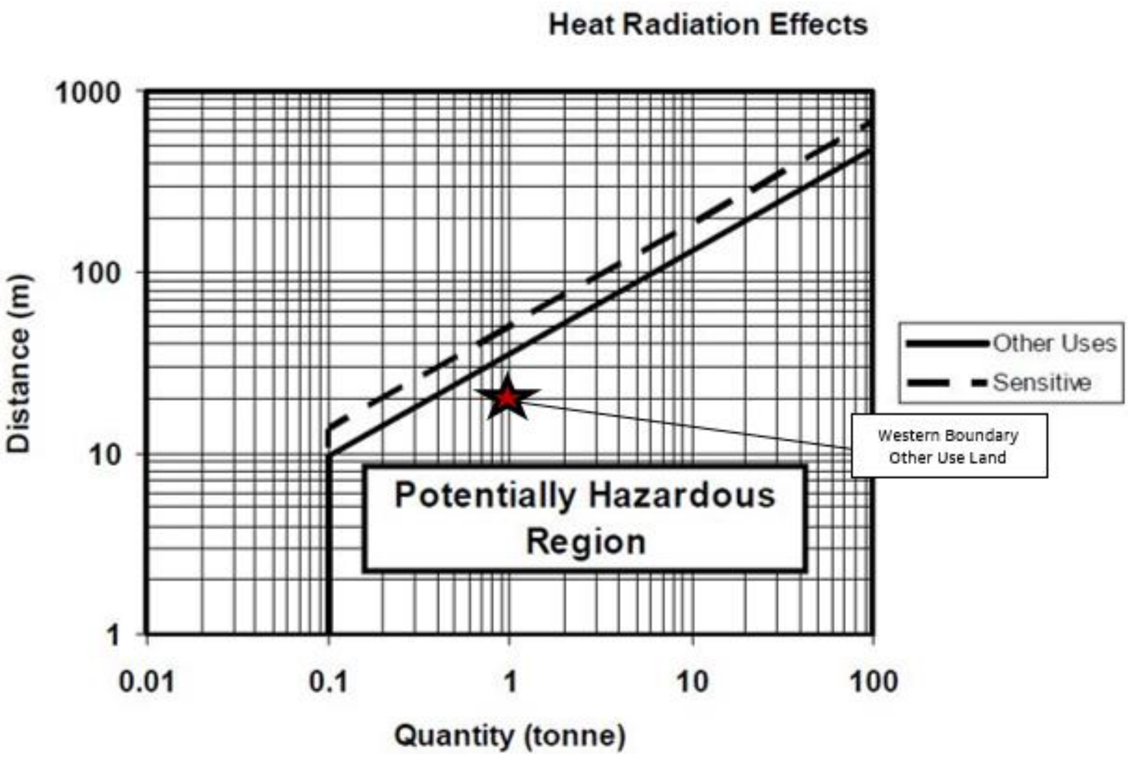


Figure 10.1: Heat radiation effects of gas (after NSW, 2011)

The risk of external consequence is estimated based on 1,300 kg of Class 2.1 flammable gas using International Atomic Energy Agency (IAEA,1996) Classification of Substances by Effect Categories method. The method considers toxicity effect, vapour / flammability effect and explosion effect. Consideration is given to dangerous goods type and class, quantity, impact range and at-risk population exposure adjusted for distribution and anticipated risk mitigation. Based on the above result, the screening of the quantity of 1,300 kg of Class 2.1 flammable gas stored inherently in the process within the Proposal Site indicates that while it is hazardous, it is categorised as Non-serious Harm. The risk classification and prioritisation assessment indicates that off-site risks are categorised as Non-serious Harm Potential, and therefore semi-quantitative and qualitative levels of analysis are not required.

Nonetheless, during agency consultation the DPIE Hazards Team requested semi-quantitative modelling be undertaken. Therefore the ALOHA (Areal Locations of Hazardous Atmospheres) software model was used to model gas supply system rupture, gas dispersion and ignition events, then the consequence predictions for thermal radiation and (explosion) blast overpressure for full-bore (the diameter of the pipeline) and 3 inch (76 mm) ruptures in the high pressure (at the GRS) and low pressure (at the gas turbine, but representative of all the gas infrastructure within the power station) gas systems.

In terms of a jet fire (where the gas ignites at the moment that the pipeline is ruptured), the thermal radiation was compared to the risk criteria from HIPAP Paper No 4 – Risk Criteria for Land Use Safety Planning (NSW, 2011). The ALOHA analysis indicates that serious consequences associated with high-pressure, full-bore rupture fire would be experienced within the Proposal Site and extend to slightly outside the boundary, and could have consequences potentially resulting in pain or injury across neighbouring industrial land use areas to 255 m radius. High-pressure, 3 inch rupture heat radiation consequences would not extend beyond the Proposal Site boundaries, except on the western boundary with adjoins rural bushland. Both low-pressure rupture heat radiation consequences would be contained to the Proposal Site. The analysis indicated that sensitive land use including the rural residential land use at 1.15 km would not be impacted.

In terms of overpressure from a gas cloud explosion (where the gas accumulates in a cloud for up to about two minutes and then ignites), the ALOHA analysis indicates that consequences associated with high-pressure, full-bore rupture blast overpressure could be experienced 250 m radius and therefore there is potential to impact the Proposal Site and neighbouring industrial land use areas. High-pressure, 3 inch rupture blast overpressure consequences would not extend beyond the Proposal Site boundaries, excepting the western boundary adjoining rural bushland. All low-pressure rupture overpressure consequences would be limited to within the Proposal site boundary. The analysis indicated that residential land use would not be impacted.

Principally due to the low inventory mass and then additionally due to the separation distance to sensitive land use, low population densities and complementary proposed neighbouring industrial land use to the Proposal Site, the Proposal is not expected to significantly impact surrounding land use safety. Table 10.1, Table 10.2 and Table 10.3 reflect the assessment of the proposed power station by the HIPAP Paper No 4 – Risk Criteria for Land Use Safety Planning (NSW, 2011) land-use risk criteria.

Table 10.1: Individual Injury Risk Criteria analysis (after NSW, 2011)

Injury Risk Event	Risk Criteria (injuries per million per year)	Criteria Assessment
Heat Radiation [4.7 kW/m^2] – residential and sensitive land-use	50	Outside Consequence Zone
Explosion Overpressure [7 kPa] – residential and sensitive land-use	50	Outside Consequence Zone
Industrial Applications	50	Criteria Satisfied

Table 10.2: Individual Fatality Risk Criteria evaluation (after NSW, 2011)

Land Use	Risk Criteria (fatal injuries per million per year)	Criteria Assessment
Hospitals, schools, child-care facilities, old age housing	0.5	Outside Consequence Zone
Residential, hotels, motels, tourist resorts	1	Outside Consequence Zone
Commercial developments including retail centres, offices and entertainment	5	Outside Consequence Zone
Sporting complexes and active open space	10	Outside Consequence Zone
Industrial Applications	50	Criteria Satisfied

Table 10.3: Property Damage Risk Criteria evaluation (after NSW, 2011)

Property Damage Risk Event	Risk Criteria (property damage per million per year)	Criteria Assessment
Heat Radiation [23 kW/m^2] – industrial / hazardous installation zoning	50	Criteria Satisfied
Explosion Overpressure [14 kPa] – industrial / hazardous installation zoning	50	Criteria Satisfied

The social risk level of multiple fatalities is deemed mitigated as low as reasonably practicable (ALARP) essentially by event likelihood, controls, containment of risk consequences, separation distance to sensitive land uses and low population density. The environmental risks associated with diesel fuel transport, storage and handling are low and will be further mitigated by diesel tank design, bund systems, road tanker delivery, unload process and facilities and the spill management protocols associated with site wastewater management. The preliminary hazard analysis of the Proposal (inclusive of the GRS) indicates that hazardous event effects meet the injury, fatality and property damage risk evaluation criteria.

In addition to flammable gas fire and explosion, the preliminary hazard analysis considered and assessed a broad range of credible major hazard events, operational hazards and environmental impacts. No unusual risks have been identified that cannot be mitigated through the application of good industry practice, safety in design processes and operating practices. The Proponent has a long history of power generation and has developed and operates similar gas fired power stations across different Australian jurisdictions. The Proponent has demonstrated systems to manage risks to satisfy enterprise and industry standards and to comply with statutory requirements.

10.1.4 Mitigation measures

A third party would be responsible for the design, approval, construction and operation of the gas lateral and associated GRS. They will need to comply with all approval requirements and demonstrate that the risks are as low as reasonably practicable (ALARP).

At this early stage of design, the Proponent has considered and included a number hazard control and risk treatments into the Proposal to benefit safety and mitigate harm. In summary these include:

- Location of the Proposal Site in a proposed heavy/general industry zoned land package on the edge of a planned industrial estate
- Positioning of the Proposal Site adjoining undeveloped rural bushland and future industrial land uses
- Positioning of the Proposal Site remote to existing sensitive land uses

- Positioning of the gas turbines and GRS within the Proposal Site to provide maximum distance to future industrial land uses
- Provision of a buffer zone extending south from the actual power station footprint
- Minimising dangerous goods and hazardous chemical transport, storage and handling at the Proposal Site.

Mitigation measures to be included in future project planning phases are outlined below.

Reference	Mitigation measure	Timing
PHA1	Consideration of hazards, risks and safety will be prioritised in the selection and design processes and equipment specifications, construction, commissioning and operation.	Detailed design, construction and operation
PHA2	The findings of the PHA and hazard table compiled during the risk workshop will be considered in future design stages and HAZOP workshops to minimise hazards and risks.	Detailed design, construction and operation

10.2 Bushfire prone land

This assessment identifies the potential risks and impacts associated with bushfire and bushfire protection at the Proposal Site and within the surrounding landscape. The assessment was informed by a Bushfire Assessment Report (Appendix F) and was developed following guidance from the NSW Rural Fire Service (RFS), particularly *Planning for Bush Fire Protection* (RFS, 2019a). To the extent that they are applicable to the Proposal, this section also follows bushfire safety guidance developed by and for NSW electricity network operators.

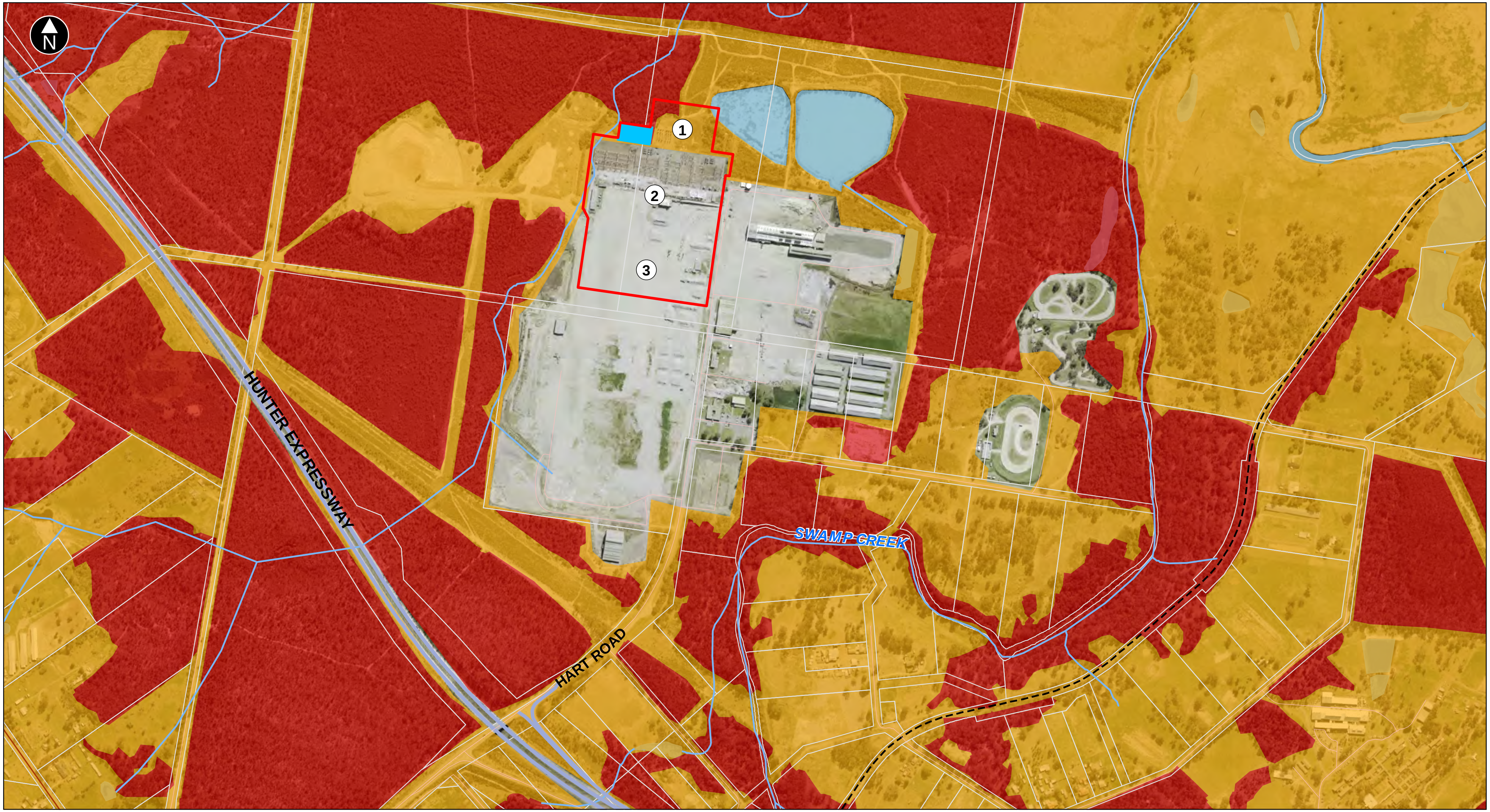
10.2.1 Assessment methodology

The assessment reviewed NSW legislation, policy and guidelines in relation to planning for bushfire protection, and examined the Proposal Site in the context of its physical characteristics and attributes that influence bushfire risk (terrain, topography, hydrology, vegetation, surrounding land use, climate and bushfire history). Through investigation of likely fire behaviour under the prevailing conditions at the Proposal Site, and the extent to which the Proposal itself may influence fire behaviour, the assessment arrived at recommendations to guide the future establishment of bushfire protection measures such as asset protection zones.

10.2.2 Existing environment

Bushfire risk context

The Proposal Site is flat and mostly cleared of vegetation. The site is adjacent to bushfire prone vegetation to the north and west and currently includes a small area of native vegetation (that will be cleared as part of the Proposal). Most native vegetation in the vicinity of the Proposal Site is Category 1 high bushfire risk vegetation (Figure 10.2) and comprises the vegetation communities listed in Table 10.4. There are also large patches of Category 3 moderate bushfire risk vegetation to the west and north-west of the Proposal Site.

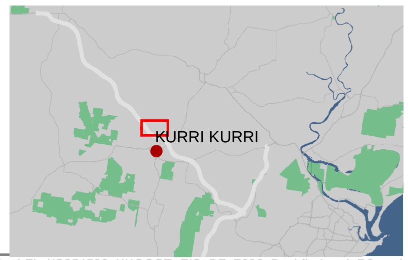


Proposal site
Detention basin
Motorway
Main roads
Roads
Railway
Waterbodies
Cadastre
Category 1: High bushfire risk
Category 3: Moderate bushfire risk

1 Proposed Switchyard Area
2 Proposed Plant Area
3 Proposed Buffer Area

0 250 500 m

1:12,000 at A4
Coordinate System: GDA2020 MGA Zone 56



Data sources:
Jacobs 2020
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 10-2 Bushfire prone land surrounding the Proposal Site

snowyhydro renewable energy Jacobs

Table 10.4: Plant community types (PCT) and Keith vegetation classifications for the bushfire study area (NSW OEH, 2019)

PCT	Plant community type description	Keith vegetation classification
1633	Parramatta Red Gum - Narrow-leaved Apple - Prickly-leaved Paperbark shrubby woodland in the Cessnock-Kurri Kurri area	Dry Sclerophyll Forests (Shrub/grass sub-formation)
1737	Typha rushland	Freshwater wetlands (Coastal Freshwater Lagoon)

Except for two small areas within the proposed location of the electrical switchyard, the entire Proposal Site has been cleared of native vegetation. As shown in Figure 10.2, parts of the proposed electrical switchyard includes land that is currently classified as high and moderate bushfire risk (Category 1 and 3). The northern and western edges of the Proposal Site are located within buffer areas for Category 1 and 3 vegetation, with the remainder of the Proposal Site not classified as bushfire prone.

In addition to the areas of native vegetation that surround the Proposal Site, the area has rural residential, agricultural and industrial land in the vicinity. The nearest residential area is Kurri Kurri, located approximately 2 km south and south-west of the Proposal Site.

Landscape bushfire risks to the Proposal arise mainly from the large patch of bushfire prone vegetation (Coastal Swamp Oak Forest vegetation community) located to its north and west. Smaller fragments of this vegetation community are also located to the east of the site.

Current bushfire management arrangements

Bushfire management arrangements for the region in which the Proposal is located are described in the Hunter Bush Fire Management Committee's (BFMC) Bush Fire Risk Management Plan (BFRMP; Hunter BFMC, 2009) for Cessnock and Maitland local government areas (LGA).

The Hunter BFRMP identified the former Hydro Aluminium Kurri Kurri (Hydro Aluminium) aluminium smelter facility (within which the Proposal is located) as a priority 1C (extreme risk) area and specified several risk mitigation strategies, including hazard reduction and property planning. The former Hydro Aluminium facility is set within an Asset Protection Zone (APZ) and is surrounded by a Strategic Fire Advantage Zone (SFAZ) that extends over the surrounding native vegetation and grassland.

APZ's are intended to protect human life, property and highly valued public assets and values and are developed to enable the safe use of direct attack suppression strategies. SFAZ seek to provide strategic areas that will reduce the speed and intensity of bushfires, reduce the potential for spot fire development and contain fires within management boundaries. They are managed to provide for parallel and/or indirect suppression strategies under elevated fire weather conditions. Bushfire fuel hazard within the SFAZ is intended to be maintained below 'high' (Hunter BFMC, 2009).

Transmission line corridors servicing the region in the vicinity of the Proposal Site are also regularly maintained to reduce the hazard posed by woody vegetation.

The area surrounding the Proposal Site is relatively well-served by fire response services. The nearest Fire and Rescue NSW station is located at Lang Lang St, Kurri Kurri, approximately 4 km to the south of the Proposal Site. The NSW RFS has a control centre at East Maitland, approximately 8 km from the Proposal Site.

Weather Conditions

The Proposal Site experiences a warm temperate climate. Summers are warm and relatively wet and winters are cooler and relatively dry (Figure 10.3). Average daily maximum temperatures range between 18°C in July and 30°C in January. Temperatures in excess of 40°C have been recorded in the months between October and March. The hottest recorded temperature is 47.0°C (February 2017). Average minimum temperatures range between 6.2°C in July and 17.8°C in January. Freezing conditions have been recorded between June and September, with the lowest recorded temperature being -4.7°C (July 1970).

Average annual rainfall is 931 mm. Annual rainfall (1967-2020) has ranged between 483 mm (1980) and 1350 mm (1988). The highest recorded daily rainfall total is 243 mm (April 2015). Over 60 per cent of the yearly rainfall occurs during the warm season months of October-March.

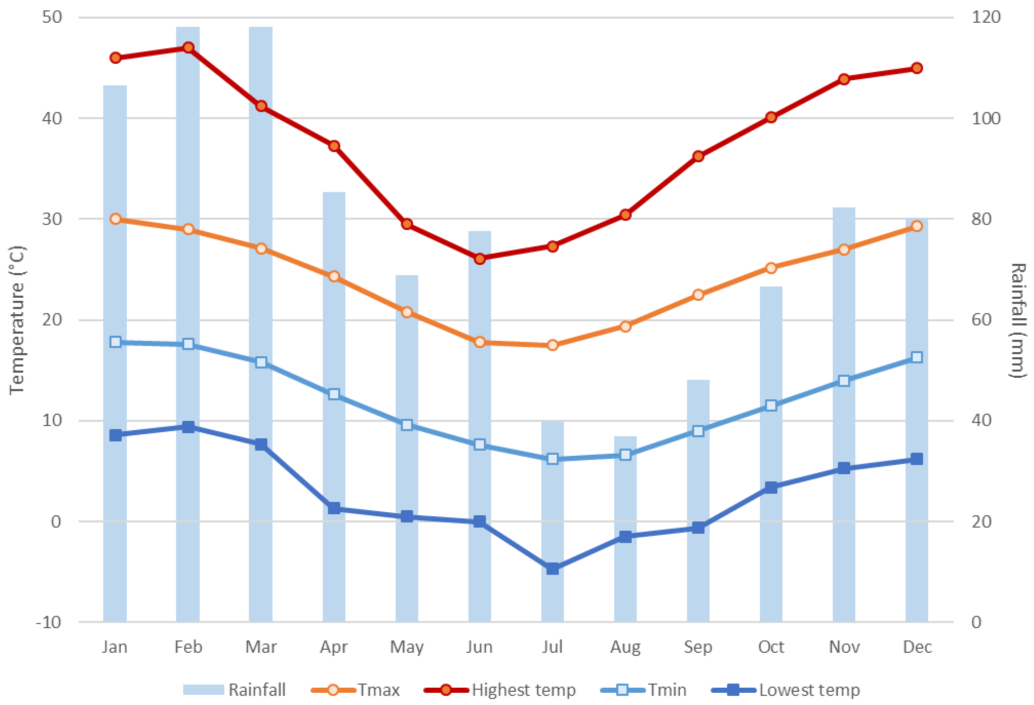
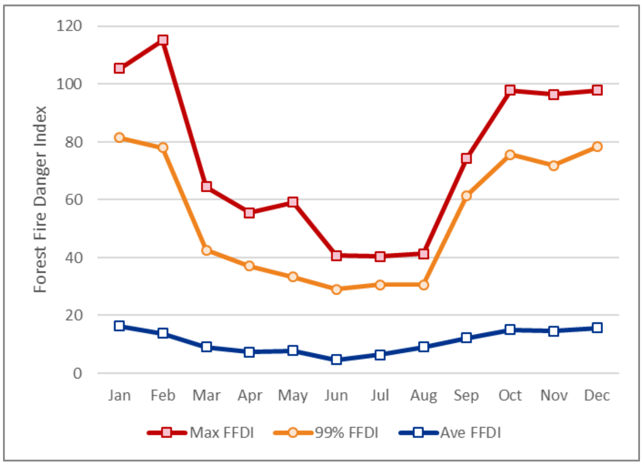


Figure 10.3: Minimum, maximum and average monthly rainfall and temperatures

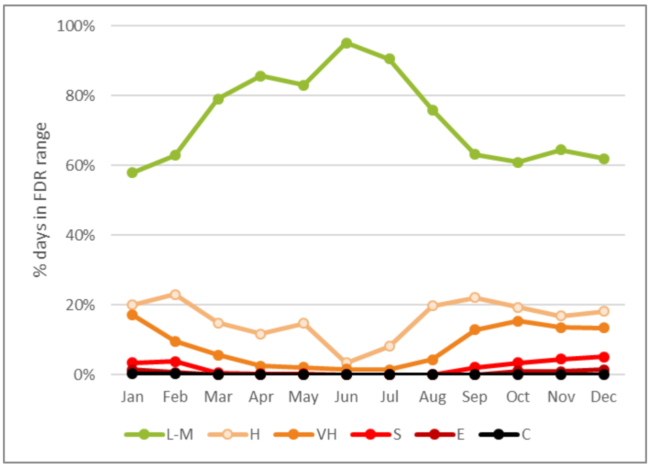
Note:

1. Meteorological records are based on Bureau of Meteorology station 061250 Paterson (Tocal AWS) for the period 1967-2020. This weather station is located approximately 23 km from Kurri Kurri. Meteorological stations at Cessnock and Maitland are closer than Paterson, but have shorter lengths of record, particularly for temperature.

Average monthly fire danger ratings (FDR) are in the low to moderate range between March and September (Forest Fire Danger Index [FFDI] ≤12) and high throughout the remainder of the year (Figure 10.4). Days of very high FDR or greater (FFDI ≥25) may occur in any month. Days with catastrophic fire danger (FFDI>100) have been recorded in January and February (only once in each month). Days in the extreme fire danger range (FFDI 75-100) have been recorded in each month between October and February.



a) Monthly values of maximum FFDI, 99th percentile of daily maximum FFDI and average daily FFDI. (Source: Paterson [Tocal AWS 061250] based on 2004-2019 records)



b) Percentage of days with maximum daily FFDI in each fire danger rating scale (L-M low-moderate; H high; VH very high; S severe; E extreme; C catastrophic) (Source: Paterson [Tocal AWS 061250] based on 2004-2019 records)

Figure 10.4: Estimated forest fire danger index (FFDI) and fire danger rating (FDR)

Total Fire Bans (TOBANs) are declared by the NSW RFS. During TOBANs, potential human sources of ignition are prohibited or restricted. FDR on TOBAN days is typically very high or greater.

The bushfire season generally runs between October and March (Hunter BFMC, 2009). Days with north-westerly winds, high daytime temperatures and low humidity are most commonly associated with dangerous fire weather conditions in Hunter BFMC region. Dry lightning storms are common in the mountains in the west of the region during the bushfire season.

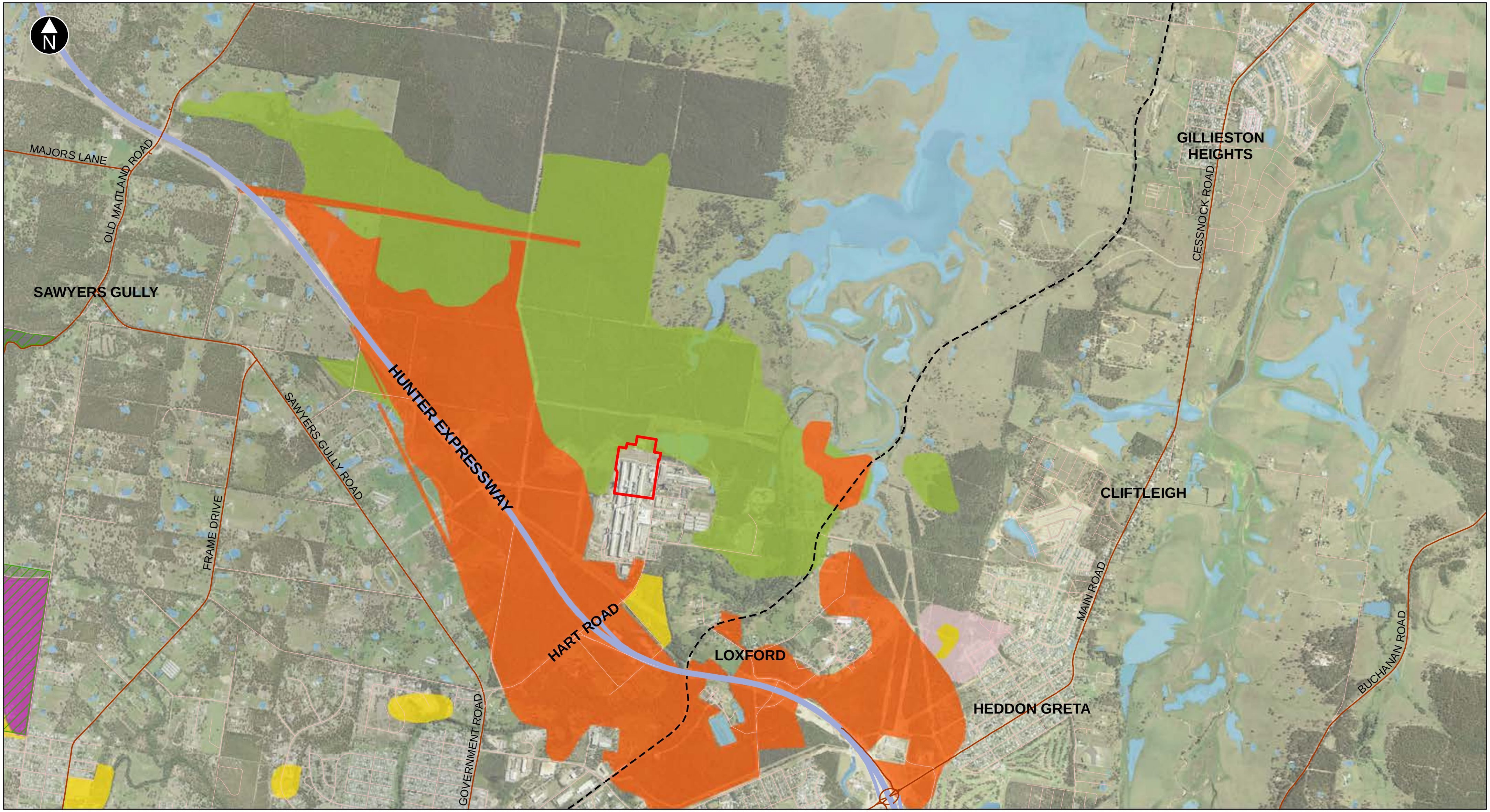
Fire history and ignition sources

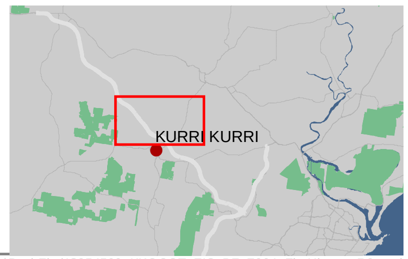
According to the Hunter BFRMP, the main ignition sources in the landscape surrounding the Proposal Site are:

- Arson – most common around townships, roads and trails; in grassy areas (which are more accessible than forests) and during school holidays
- Escaped planned burns
- Illegal burning activities
- Arcing distribution power lines
- Motor vehicles.

The Hunter bushfire management area (Cessnock and Maitland LGAs) records, on average, approximately 200 bushfires per year. About five of these develop into major fires each year, on average. Larger and more damaging fires in the region typically travel in an easterly direction under the influence of north-westerly or westerly winds. In some circumstances, strong southerly and/or easterly wind changes may intensify fire events.

The fire history of the area surrounding the Proposal Site is shown in Figure 10.5. The main bushfires occurred in the 2002-03 and 2016-17 seasons. These burnt from the north-west towards the south-east and affected bushland and adjacent rural land areas. They burnt to the boundary of the former Hydro Aluminium facility. The 2002-03 bushfire burned through the site of the proposed switchyard at the northern end of the Proposal Site.





Proposal site
NPWS estate / reserve
Motorway
Main roads
Roads
Railway
Waterbodies
1995-96 Wildfire
1997-98 Wildfire
2001-02 Wildfire
2002-03 Wildfire
2006-07 Wildfire
2016-17 Wildfire

1:40,000 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs 2020
NearMap 2020
NSW Spatial Services

Figure 10-5 Fire history

Date: 5/03/2021 Path: J:\IE\Projects\04_Eastern\IS354500\22_Spatial\GIS\Directory\Templates\Figures\KurriKurriEIS\Specialists\BushFire\IS354500_KKOCGT_EIS_BF_F004_FireHistory_R2.mxd
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10.2.3 Impact assessment

Key bushfire risk scenarios

The key bushfire scenarios that may affect the Proposal are:

- *Scenario 1:* A fire ignites in or burns into the native vegetation areas to north-west of the Proposal Site on a day of elevated fire danger, with strong north-westerly to westerly winds. Under such conditions, embers and smoke would carry towards the Proposal Site and any persons present would be exposed to radiant heat.
  This scenario describes circumstances where bushfires would pose the greatest risk to the Proposal Site and personnel operating there. It includes the most severe fire weather conditions and describes circumstances where a bushfire would be burning through areas with the greatest bushfire fuel accumulation. Under such conditions, a bushfire could burn in high bushfire risk vegetation almost to the boundary of the Proposal Site.
  This scenario reflects the two largest fires depicted in Figure 10.5 and based on these experiences, might be expected to occur once every 10-20 years, not accounting for the influence of climate change.
- *Scenario 2:* Electrical equipment failure (most likely explosive failure of a transformer), or hot works result in fire ignition at the Proposal Site. Fire escapes into native vegetation to the west or north west and then spreads under moderated fire weather conditions influenced by relatively humid southerly or easterly winds. Given the anticipated separation between the Proposal Site and bushfire prone vegetation, this scenario is considered unlikely. However this scenario provides the most likely situation for a fire, caused by activities at the Proposal Site, to escape into the surrounding landscape.

Bushfire attack level exposure

Should native vegetation catch fire in the vicinity of the Proposal Site, it would potentially expose the power station and/or electrical switchyard infrastructure to radiant heat and embers. The level of exposure to bushfire attack (the bushfire attack level or BAL) is depicted in Figure 10.6.

Proposal Site
Detention basin
Asset protection zone
Motorway
Roads
Railway
Waterbodies
Cadastre

BAL
Flame zone
BAL-40
BAL-29
BAL-19
BAL-12.5
Bushfire prone vegetation

1 Proposed Switchyard Area
2 Proposed Plant Area
3 Proposed Buffer Area

0 250 500 m

1:10,000 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs 2020
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 10-6 Bushfire attack level exposure from bushfire prone vegetation in the vicinity of the Proposal Site

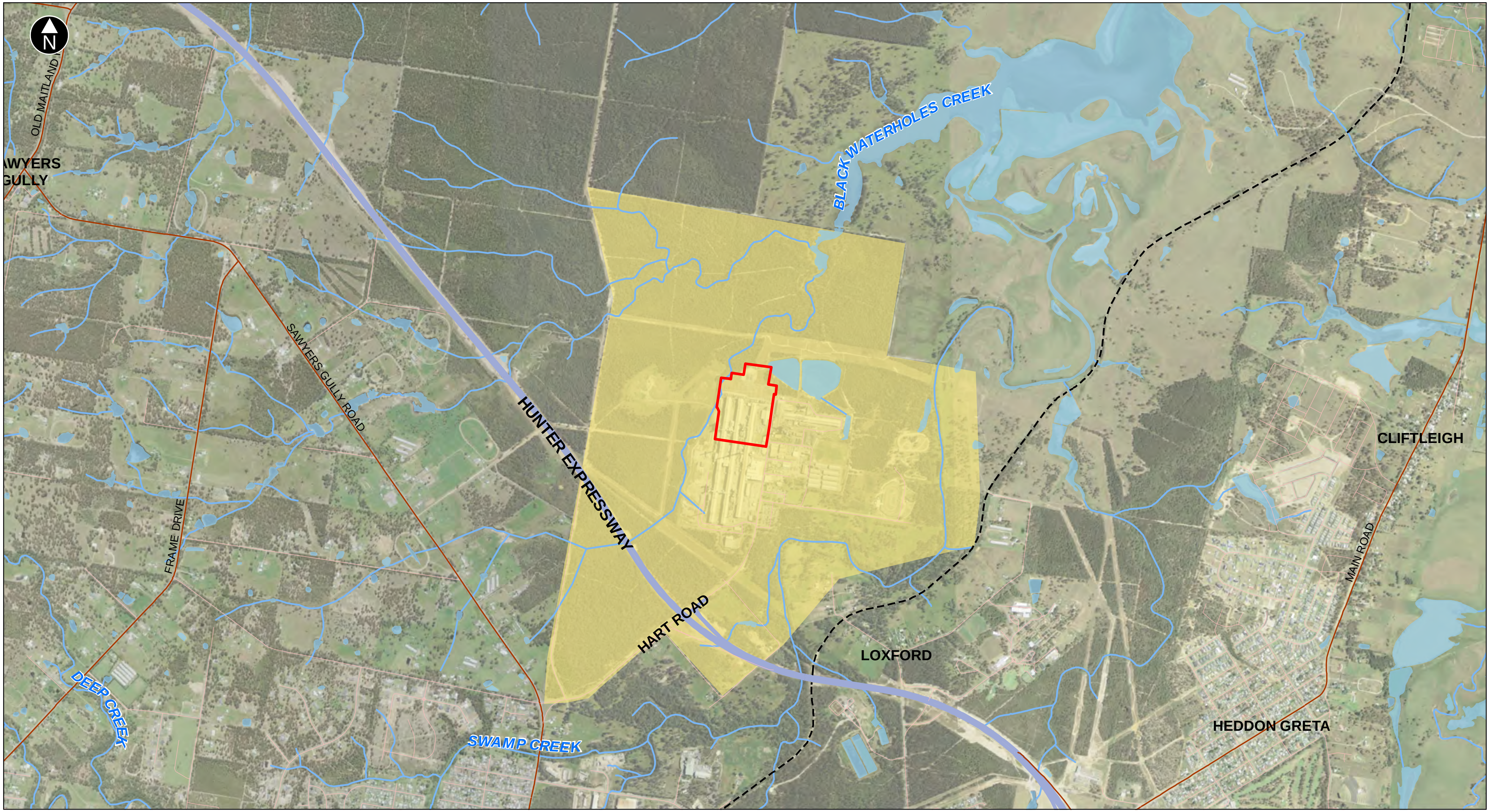
Date: 11/03/2021 Path: J:\IE\Projects\04_Eastern\IS354500\22_Spatial\GIS\Directory\Templates\Figures\KurriKurriEIS\Specialists\BushFire\IS354500_KKOCGT_EIS_BF_F003_BAL_R2.mxd
Created by : AA | QA by : KI

10.2.4 Bushfire protection: construction

Bushfire protection during construction would be based on the following suite of measures:

- *SFAZ:* management of bushfire fuel hazard in the surrounding landscape by RFS should moderate the behaviour of a fire, should one ignite, and reduce the threat it poses to construction personnel. The Hunter BFRMP (Hunter BFMC, 2009) identifies a SFAZ around the former Hydro Aluminium facility (Figure 10.7). The SFAZ includes areas of native vegetation and cleared land that surround the Proposal Site. Bushfire fuel hazard in these areas is actively maintained (by RFS) by periodic hazard reduction burning in the larger blocks of native vegetation. This is designed to moderate fire behaviour and reduce the risks posed to people and infrastructure by radiant heat and embers.
- *Site clearance:* the Proposal Site is a brownfield site that is largely devoid of bushfire prone vegetation. Most of the site would have low radiant heat exposure to any fire in nearby vegetation and any embers entering the site are unlikely to find sufficient fuel for a spot fire to establish. In case of an approaching fire in the vegetation to the north and west of the Proposal Site, workers could safely retreat towards the south-east, without necessarily needing to evacuate.
- *Access:* in the event of a fire, emergency services would access the site via Hart Road. External access (prior to construction of the proposed APZ access track) would be via the existing formal and informal track network.
- *Fire water supply:* the Proposal Site would have access to potable water from Hunter Water. A standpipe or connection point would be provided to enable fire response vehicles to refill in case of fire.
- *Hot works controls:* works that have potential to generate sparks and ignite fires would be subject to the contractor's hot works safety management procedures and could only be undertaken on TOBAN days with a permit from the RFS.

Emergency management: on site bushfire emergency management arrangements would be addressed through the construction contractor's site emergency management plan. Bushfire fighting equipment would not be held on site during construction. If a fire is ignited and cannot be safely contained using fire extinguishers or the like, construction crews would dial 000 and seek emergency service assistance.



Proposal site
Motorway
Strategic Fire Advantage Zone
Main roads
Roads
Railway
Waterbodies

0 1 2 km

1:30,000 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs 2020
Aerometrex 2020
NSW Spatial Services

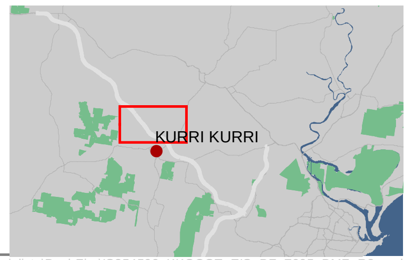


Figure 10-7 Bushfire management zoning

snowy hydro renewable energy
Jacobs

Date: 11/03/2021 Path: J:\IE\Projects\04_Eastern\IS354500\22_Spatial\GIS\Directory\Templates\Figures\KurriKurriEIS\Specialists\BushFire\IS354500_KKOCGT_EIS_BF_F005_BMZ_R2.mxd
Created by : AA | QA by : KI

10.2.5 Bushfire protection: operation

To reduce the risks from bushfire during operation of the Proposal, implementing the following bushfire protection measures is recommended:

Strategic Fire Advantage Zone

During operation, the SFAZ referred to in Section 10.2.4 above (Figure 10.7) would perform the same role as during construction. It is assumed that given the significance of the Proposal to the region and state, that the SFAZ would be maintained in future iterations of the BFRMP and that the RFS would continue to undertake periodic hazard reduction burning.

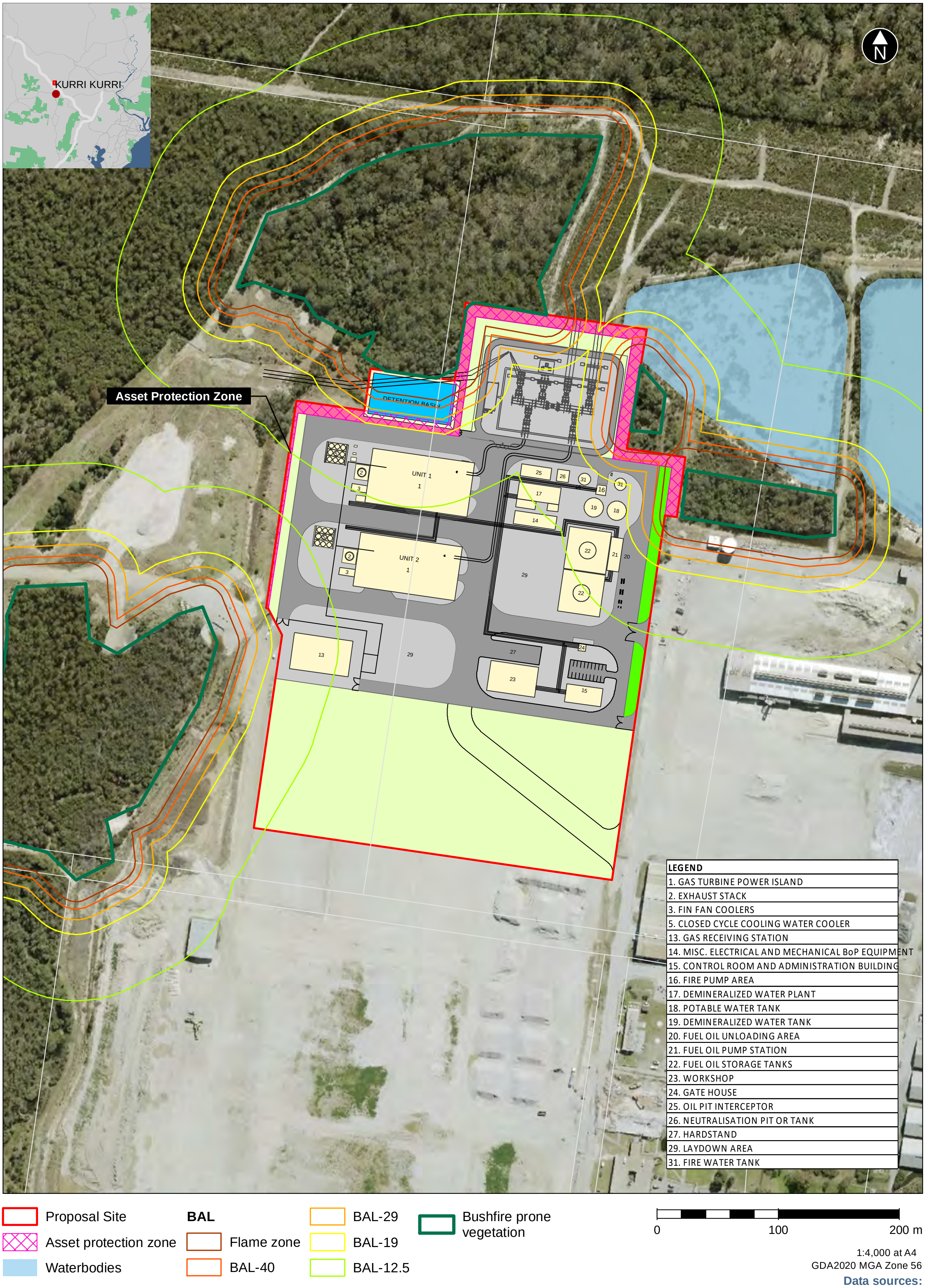
Asset Protection Zone

APZ provide a low fuel hazard buffer between buildings (or other structures) and a bushfire hazard. They create a space to help manage the flame, radiant heat and ember exposure of the structures and any emergency service personnel or other persons. They typically require the removal of native overstorey vegetation and regular maintenance of the grasses, sedges or low shrubs that form the understorey.

A 10 m APZ is proposed for the Proposal Site, as per Figure 10.8. This is consistent with:

- *ISSC3 Guide for the management of vegetation in the vicinity of electricity assets (*Industry Safety Steering Committee [ISSC], 2016) specifications for APZ for substations/switchyards).'
- Planning for Bushfire Protection (NSW RFS, 2019a) specifications for renewable energy generation facilities.

An APZ is identified around the outside of the Proposal Site. As shown in Figure 10.8, it would not need to be maintained around most of eastern boundary, all of the southern boundary or part of the western boundary of the Proposal Site, where the land is not designated as bushfire prone and there is no vegetation.



Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 10-8 Asset Protection Zone for Proposal Site

Approximately 0.39 ha of native vegetation would be cleared to establish the APZ. An access track would be constructed within the APZ to provide access for fire-fighting vehicles to bushfire-prone land adjacent to the Proposal Site that currently does not have a formed track. The APZ is proposed to be constructed outside the Proposal Site's boundary fence to ensure fire response vehicles and personnel are separated from electrical infrastructure within the power station and (particularly) the electrical switchyard. It is recommended that all vegetation present within the APZ be kept to a maximum height of approximately 10 cm under very dry conditions, and approximately 20 cm at all other times. Periodic mowing/slashing is expected to maintain this standard.

Location of sensitive buildings

The majority of the Proposal Site is not expected to be exposed to radiant heat from a bushfire of more than 12.5 W/m^2 (BAL-12.5; see Figure 10.6; measurement unit is watts per square metre). Allowing for the proposed APZ, a relatively small part of the Proposal Site would potentially be exposed to radiant heat levels above BAL-19. To mitigate the risk posed by radiant heat, any sensitive elements of the Proposal would be located outside areas of the site with potential exposure exceeding BAL-19.

Hazardous materials

The Proposal has been designed to operate using diesel fuel if gas is unavailable. It would therefore be necessary to construct diesel storage tanks on site. Two tanks would be constructed, as shown in Figure 10.6. The final location of these tanks would be dependent on the detailed design, however based on the concept location of these tanks, it is estimated that there is a potential that radiant heat exposure (BAL) of 12.5-19 W/m^2 would be prevalent in this area of the Proposal Site. These diesel storage tanks would be constructed in line with environmental protection guidance and designed so as to avoid the accumulation of embers or bushfire fuels that could ignite under ember attack. The sensitivity of the diesel storage tanks to radiant heat exposure would be confirmed during detailed design and risk mitigations implemented if required.

Vehicle access

Access to the Proposal Site would be off Hart Road which connects directly to the Hunter Expressway south of the Proposal Site. Internal roads within the Proposal Site would be available for emergency services and would be a minimum of 4 m wide and have a minimum vertical clearance of 4 m. A fire access track is to be constructed within the proposed external APZ (Figure 10.8). This would be constructed to a standard that allows use by fire response vehicles (as specified in NSW RFS fire trail standards [RFS, 2019b] for *Category 1 fire appliances*).

Water for firefighting

The Proposal Site would be serviced by potable water from a new connection to the existing Hunter Water network. This would be supplemented by two fire water storage tanks to ensure the Proposal can meet peak cooling demands. Fire water for bushfire responses would be provided via standpipes.

10.2.6 Mitigation measures

Bushfire risks during construction and operation would be mitigated in accordance with the measures set out in Table 10.5.

Table 10.5: Bushfire mitigation measures

Reference	Mitigation measure	Timing
BF1	Bushfire risk during construction will be managed in accordance with the Hunter Bush Fire Management Committee's (BFMC) Bush Fire Risk Management Plan (BFRMP; Hunter BFMC, 2009). Site bushfire emergency management arrangements will be addressed through the construction contractor's site emergency management plan detailing site evacuation protocols, emergency vehicle access, and water supply for fire fighting.	Construction
BF2	Hot works controls: the Contractor will prepare and implement hot works safety management procedures. Works having the potential to generate sparks or ignite fires will be undertaken on total fire ban days only in accordance with a permit from the NSW Rural Fire Service.	Construction
BF3	Bushfire fuel hazard in the surrounding landscape will be managed in accordance with the Hunter Bush Fire Risk Management Plan. A 10 metre Asset Protection Zone will be established for the Proposal Site, consistent with: ▪ *ISSC3 Guide for the management of vegetation in the vicinity of electricity assets (*Industry Safety Steering Committee [ISSC], 2016, specifications for APZ for substations/switchyards) ▪ *Planning for Bushfire Protection* (NSW RFS, 2019) specifications for renewable energy generation facilities.	Construction and operation

10.3 Plume rise and aeronautical impact and risk assessment

This assessment was informed by an Aeronautical Impact and Risk Assessment, prepared by Strategic Airspace, including the associated Plume Rise modelling (Appendix G). The Aeronautical Impact and Risk Assessment was undertaken to determine the extent of gas turbine exhaust plumes generated by the Proposal.

10.3.1 Assessment methodology

The potential plume rise extent has been investigated in accordance with methods prescribed by the Civil Aviation Safety Authority (CASA) to meet CASA and Airservices Australia requirements. The approach to plume rise assessment is documented in CASA's Advisory Circular 139-5 "Plume Rise Assessments" (January 2019). This document identifies that high velocity vertical gas/exhaust plumes are a potential hazard to aircraft operations, and applies a risk assessment methodology that is based on likelihood of impact, taking into account the likely plume exit velocity, obstacle limitation surfaces, (PANS-OPS), and other considerations such as whether aircraft are operating under visual flight rules or instrument flight rules, the types of aircraft operations occurring in surrounding airspace, and the amount of air traffic.

The methodology is guided by the current criteria used by CASA, as follows:

- If a plume has an exit velocity greater than 6.1 m/s then it must be assessed by CASA
- CASA will only consider a plume rise as a hazard to aviation if it is likely to interfere with aircraft operation when aircraft are vulnerable (generally, for aircraft to be vulnerable they would be travelling at low speed at low altitude with the aircraft configured for take-off or landing, when pilot is likely to have a high workload)
- CASA would not consider a plume with a velocity greater than 10.6 m/s at an altitude at which aircraft operate as safe for aircraft to fly through (as this is severe turbulence), unless all such aircraft were heavy, traveling at high speed and appropriately configured.
- At any given altitude where the velocity might be between 6.1 m/s and 10.6 m/s CASA would probably apply a risk assessment using factors such as: number of different types of aircraft, weight and speed of aircraft, likely configuration, likely workload and opportunity to avoid the plume.

10.3.2 Existing environment

The approximate location of the Proposal's two gas turbine exhaust stacks is provided in Table 10.6.

Table 10.6: Reference Assessment Coordinates

Gas Turbine Stack	Geographic Coordinates – Latitude and Longitude	GDA94-MGA Coordinate Conversion Easting & Northing (Zone 56)
OCGT1	32° 47′ 07.722″ S 151° 28′ 42.682″ E	357520 E 6371471 N
OCGT2	32° 47′ 09.958″ S 151° 28′ 42.259″ E	357510 E 6371402 N

Nearby Aerodromes

The two closest aerodromes are Maitland and Cessnock Airports located 9.5 km and 13 km from the Proposal Site respectively. The location of these aerodromes relative to the Proposal Site are shown in Figure 10.9. There are also a number of other aerodromes in the wider vicinity of the Proposal Site, as summarised in Table 10.7.

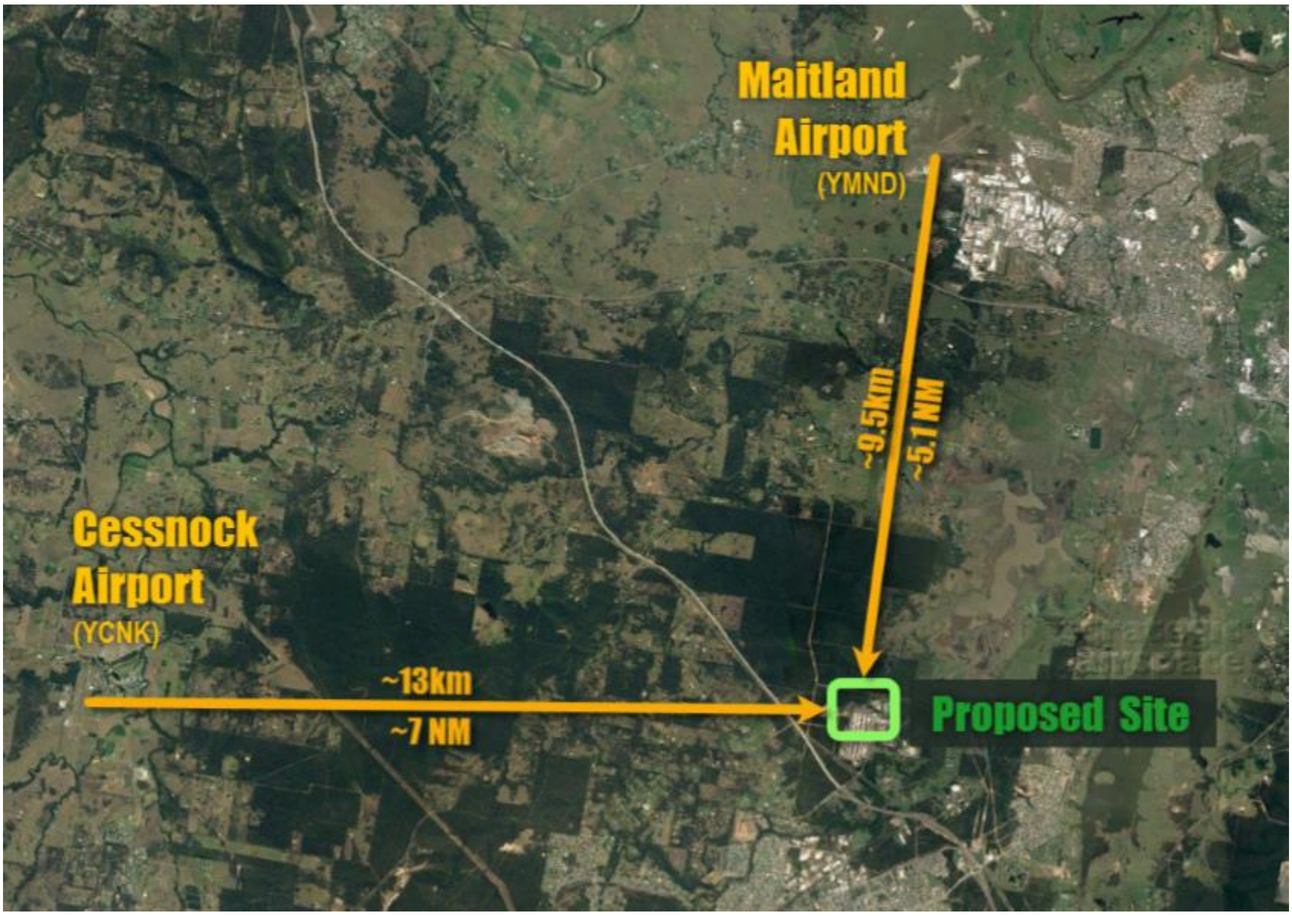


Figure 10.9: Location of the Proposal Site relative to the Two Nearest Airports: Maitland and Cessnock

Table 10.7: Aerodromes surrounding the Proposal Site

Aerodrome (ICAO Designator)	Distance from Proposal Site	Orientation relative to Proposal Site	Significance
Maitland (YMND)	9.5 km	N	General aviation and flight training
Cessnock (YCNK)	13 km	E	General aviation and flight training
Luskintyre (YLSK)	14 km	NNW	Aircraft restoration and museum
Elderslie (YEES)	24 km	NNW	General aviation and flight training
Dochra (YDOC)	29 km	WNW	Military reserve air strip
Williamtown (YWLM)	33 km	E	Joint civil/military airport (Newcastle) RAAF operations and flight training
Singleton (TSGT)	33 km	NW	Military reserve air strip
Lake Macquarie (YLMQ)	35 km	SSE	Gyrocopter, Microlite (powered gliders), helicopter and parachuting

Aeronautical Environment

The Proposal Site is located within Class G airspace, which allows for uncontrolled flights at low altitudes, up to 8500ft. The flight schools located in Cessnock and Maitland generate a lot of low-level traffic in the area for training purposes. The area is also used for tourist and sightseeing flights transiting from Williamtown and Sydney towards the Hunter Valley. There is also some regular ultralight traffic traversing the area out of Lake Macquarie.

Figure 10.10 illustrates the aeronautical environment as shown on the Newcastle Visual Navigation Chart (VNC) in relation to the Proposal Site.

Further, approximately 1 km north of the Proposal Site is an area that is used regularly for helicopter training down to the ground. The area is approved by CASA for use as a training area as published in the Operations Manual of training schools authorised to use that training area.

The Proposal Site is under a military restricted airspace zone (R578F) which may be activated at any time by the RAAF at Williamtown which would effectively force any civil air traffic transiting over the Proposal Site to remain below 4500ft AMSL. A military danger area (D600) also covers the Proposal Site from ground to 8500ft, which would be intended to be used as a military jet corridor when activated. The size of D600 makes it highly unlikely that even when used any military jets will transit overhead the Proposal Site. D600 is shown in Figure 10.11.

The location of the Proposal Site is also shown below on the Newcastle Visual Navigation Chart (VNC) in Figure 10.10. This chart shows most of the features that a pilot might use for visual navigation (such as roads, railways, power lines, built-up areas) as well as features a pilot should be aware of (such as airspace boundaries and limits).

Figure 10.10: Site Location, highlighted on the Newcastle Visual Navigation Chart (VNC)

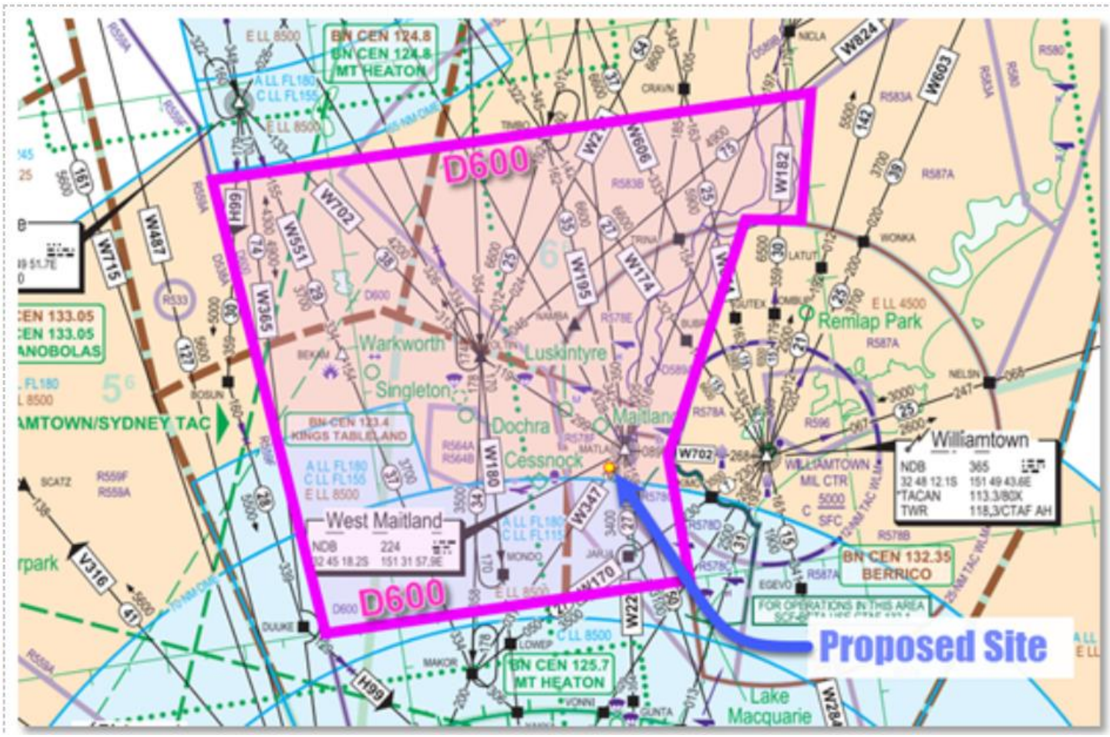


Figure 10.11: Extent of the D600 danger area

10.3.3 Impact assessment

Plume rise

The vertical velocity of the plume may be considered as a hazard to certain types of aircraft flying at low altitudes. Plume rise modelling was undertaken to identify the critical plume velocity (CPV) and critical plume height (CPH) to determine the potential level of hazard to aviation. The modelling methodology adopted for this assessment assumes continuous operation of the gas turbines and uses weather data over a five-year period.

The Plume Height / Percentage Exceedance graph below (Figure 10.12) shows the percentage of time the plume rise would be above each 'benchmark' plume velocity (4.3 m/s, 6.1 m/s and 10.6 m/s). For ultra-light aircraft, 4.3 m/s is considered a 'critical' benchmark velocity. Key heights above ground and equivalent altitudes for visual (VFR) operations and instrument (IFR) operations are shown as vertical blue lines.

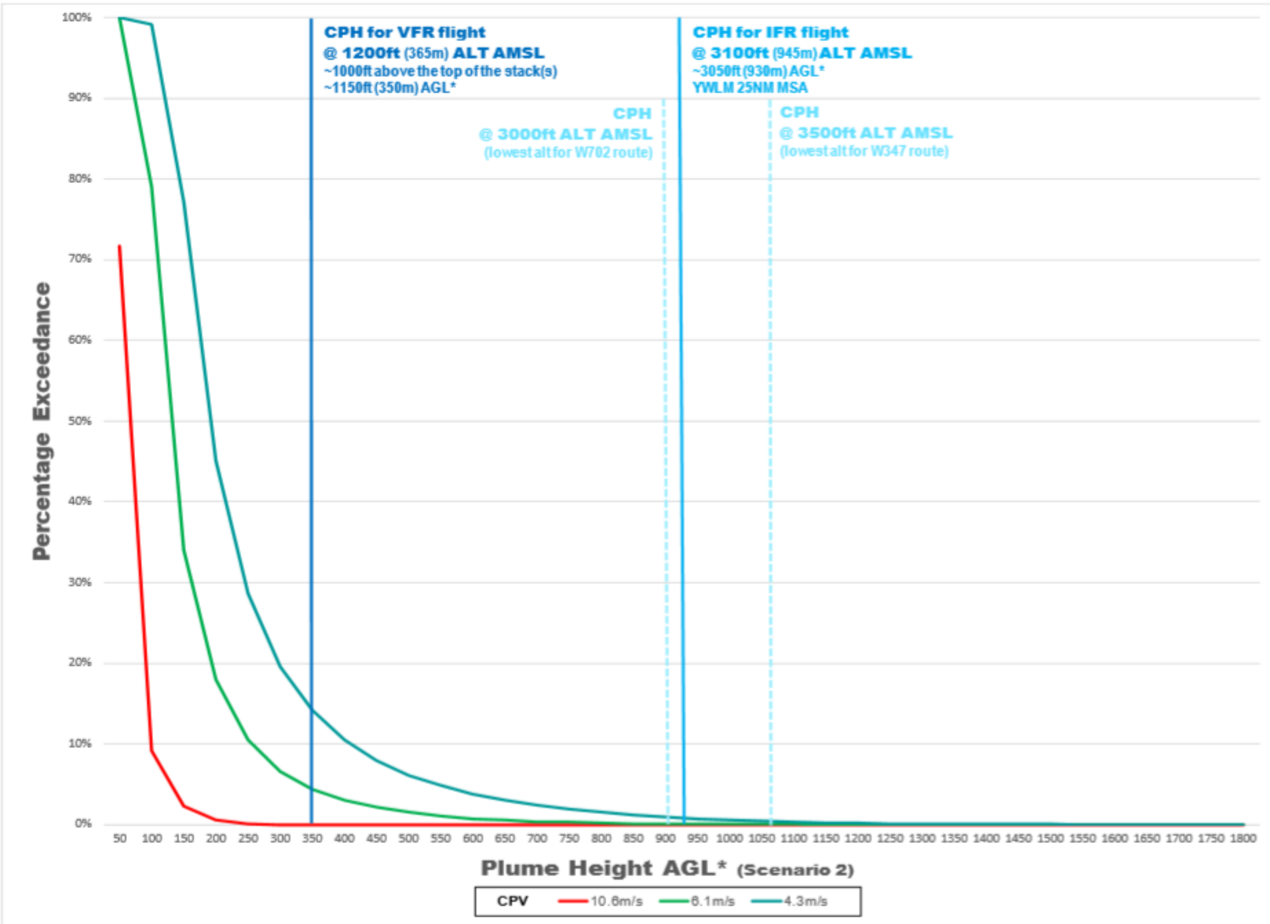


Figure 10.12: Highest CPH for Visual and Instrumental Flights

The modelling establishes the percentage exceedance assuming continuous power station operation for a full year. It does not take into account the intended 'peaking' nature of operation for the Proposal. Snowy Hydro are seeking approval to operate the Proposal at up to 10 per cent of the year on gas and up to 2 per cent of the year on diesel (e.g. up to 12 per cent total in any given year). However, it is expected that likely operation of the Proposal would be about 2 per cent in any given year. Operating at such low percentages reduces the risk to aviation near the Proposal Site.

Table 6 — Scenario Two: Statistical Frequency of Plume Exceedance by Velocity & Altitude Bands — When the Plant is Operating

EIS Scenario 2: 2 x SCGT

3σ (99.7%) Certainty of Exceedance
2σ (95.5%) Certainty of Exceedance
3σ (99.7%) Certainty of NO Exceedance
2σ (95.5%) Certainty of NO Exceedance

Frequency of plume vertical velocity exceeding 4.3, 6.1 and 10.6 m/s in height bands

Height (m AGL)	Frequency of plume vertical velocity exceeding 4.3 m/s at each height (%)	Frequency of plume vertical velocity exceeding 6.1 m/s at each height (%)	Frequency of plume vertical velocity exceeding 10.6 m/s at each height (%)	Avg ALT (ft MSL) in Vicinity
50	100.00%	100.00%	71.67%	
100	99.26%	79.07%	9.16%	430
150	77.25%	34.10%	2.28%	590
200	45.06%	17.94%	0.51%	750
250	28.59%	10.55%	0.07%	920
300	19.56%	6.62%	0.00%	1080
350	14.16%	4.33%	0.00%	1250
400	10.51%	3.02%	0.00%	1410
450	7.92%	2.09%	0.00%	1570
500	6.05%	1.48%	0.00%	1740
550	4.79%	1.05%	0.00%	1900
600	3.74%	0.73%	0.00%	2070
650	2.99%	0.52%	0.00%	2230
700	2.43%	0.34%	0.00%	2400
750	1.93%	0.25%	0.00%	2560
800	1.55%	0.14%	0.00%	2720
850	1.20%	0.10%	0.00%	2890
900	0.94%	0.07%	0.00%	3050
950	0.71%	0.04%	0.00%	3220
1000	0.55%	0.03%	0.00%	3380
1050	0.43%	0.01%	0.00%	3540
1100	0.29%	0.00%	0.00%	3710
1150	0.22%	0.00%	0.00%	3870
1200	0.14%	0.00%	0.00%	4040
1250	0.10%	0.00%	0.00%	4200
1300	0.06%	0.00%	0.00%	4360
1350	0.03%	0.00%	0.00%	4530
1400	0.01%	0.00%	0.00%	ABV R578F LL

Figure 10.13: Statistical frequency of plume exceedances

Aeronautical activity

During the day in good weather conditions pilots are allowed to fly as low as 500ft outside built-up areas, but they have to maintain a 1000ft height over built-up areas and remain 1000ft above the highest obstacle in a 10 nautical mile (NM) radius when flying at night. Local aerodromes also promote “fly neighbourly” principles, which promote the practice of flying at 500ft above the legally required minimum to reduce noise impact on the ground. As such it is reasonable to assume that most flights will pass overhead an industrial installation at no less than 1000ft above the tallest obstacle (i.e. for this Proposal, this would be the gas turbine exhaust stacks) most of the time, which in that vicinity translates to an altitude of ~1200ft AMSL.

At this altitude over the Proposal Site, the plume velocity would be almost entirely dissipated more than 95 per cent of the time if the plant operated continuously (as per the 5-year plume model simulation results). If the power station operated 2 per cent of the time (which is the likely expected duration in any given year), the frequency of exceedance of a plume velocity of 6.1 m/s over the year reduces to only approximately 0.09 per cent, which is less than once per year. This is a conservative altitude as local stakeholders have reported that, from their experience, the majority of aircraft would transit over the general Proposal Site area at altitudes between 1500 and 3500ft.

There is a CASA-approved low flying area for helicopter training north of the Proposal Site. This area, which permits helicopters to conduct training from ground elevation to 500ft AGL, is used by the helicopter training organisations based in Lake Macquarie and Cessnock. As the closest part (the south-western corner) of this area is approximately 1 km north of the Proposal Site, there should be no reason for helicopters to fly low over the Proposal Site to access this area at less than 500ft AGL.

Obstacle Limitation Surface (OLS) Analysis

The nearest runway is at Maitland Airport (RWY 05/23). At 9.1 km from the nearest runway threshold, the Proposal Site is located well clear of the OLS, which has a maximum radius of 5.5 km measured from any of the runway thresholds. The Proposal Site is also clear of the OLS of Cessnock Airport.

Instrument or PANS-OPS (IFR) Operations Assessment

All aerodromes in the vicinity of Kurri Kurri with instrument (PANS-OPS) procedures, except for Maitland, are located relatively far away from the Proposal Site (>20 km), and their runways and flight paths are oriented in such a manner, that the plume rise from the Proposal will remain clear of the flight patterns associated with those PANS-OPS procedures. There are no instrument procedures currently published for Cessnock Airport however the airport owner is planning to have an RNAV (GNSS) approach implemented in 2021-2022. This new procedure will not be affected by the Proposal's plume rise.

Visual (VFR) Operations Assessment

The following is noted about visual operations in the vicinity of the Proposal Site:

- Flight training for fixed wing and rotor aircraft occurs in the general area between Maitland and Cessnock Airports, extending across the north of Kurri Kurri and the Proposal Site, and extending east to Hexham and Mt Sugarloaf
- Accurate data on general VFR flights were not definable within the vicinity of the Proposal Site
- Key features that may be used by pilots for visual tracking and navigation include (shown in Figure 10.14):
  - There is a low flying corridor going S-N along the railway with an entry/exit point over Maitland Station approximately 8 km NNE of the Proposal Site.
  - There is a motorway just South West of the Proposal Site and a railroad track East of the Proposal Site. These features may be used for reference by pilots flying visually.
  - There are nearby powerlines to the north and east of the Proposal Site.
- There are VFR flight transiting from the south (eg, Sydney) by tourists and students to the Hunter Valley for pleasure or training flights. Pilots operating as such may take a track through a gap in the hills from the Pacific Highway during times of low visibility and/or a low ceiling, and then track north. If flying to Maitland the track is most likely to pass immediately to the east of the Proposal Site, as illustrated in Figure 10.15
- There is a military restricted area overhead of the Proposal Site with a lower limit of 4500ft, which means non-military VFR traffic must remain below that altitude when passing overhead the Proposal Site to avoid infringing the restricted area (when it is activated). This area, R578F, is depicted in Figure 10.10 above.

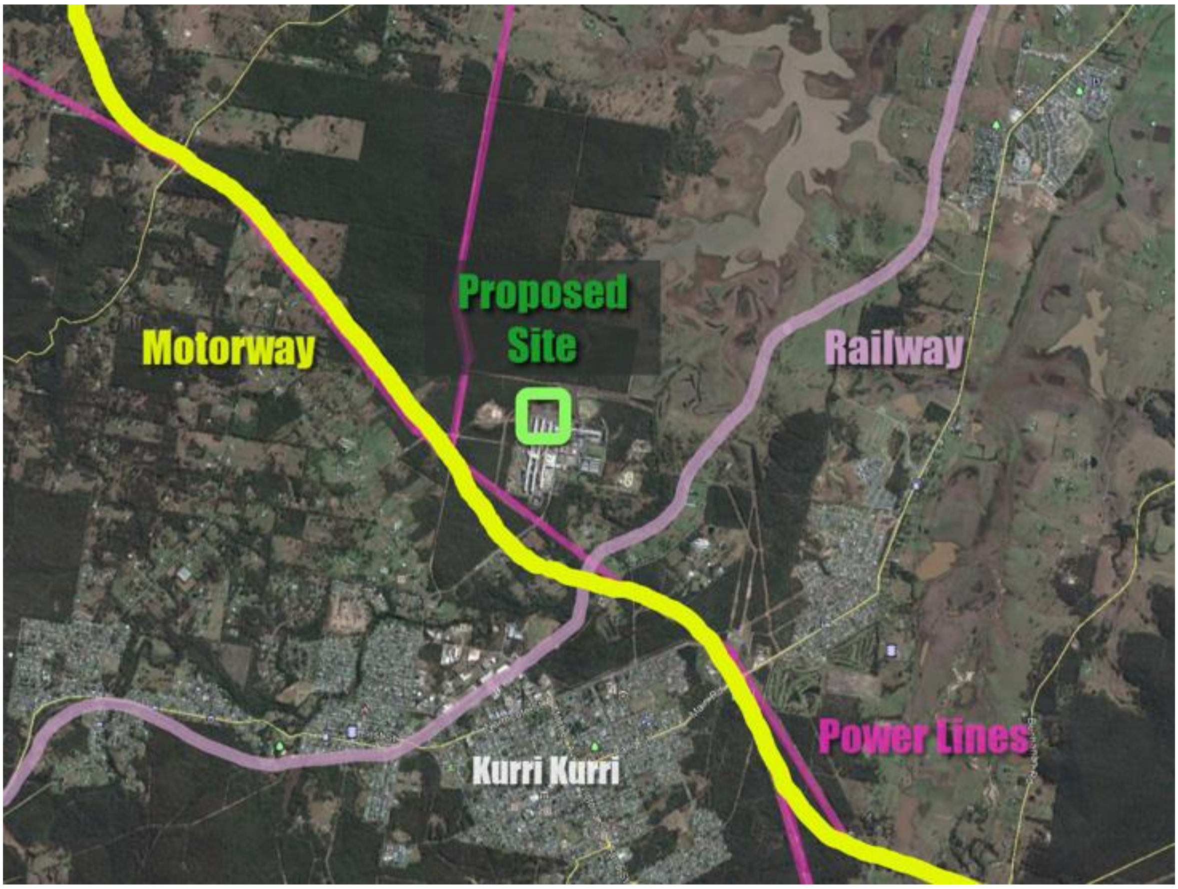


Figure 10.14: Key Features that may be used when Flying Visually

Figure 10.15: Low Flying Helicopter Training Area north of the Kurri Kurri Site & Overhead View of the VFR Transit to/from the South

Summary of impacts

All gas turbine exhaust plume rises from power stations can potentially be considered a hazard to aviation. However, the potential hazard to aviation caused by the Proposal is reduced by a number of key factors including:

- The Proposal Site is outside the circuit and circling areas of the two closest airports
- Aircraft in the area will generally be operating at cruising altitudes
- The few cases where, if an Ultralight, Helicopter or Light Aircraft were to pass over the site at 600ft AMSL (~500ft AGL) at low speed, the possible severity on those occasions where the plume rise velocity exceeded that altitude at 10.6 m/s could not be minimised — noting however that the probability of exceedance is very low (less than 0.05 per cent or approximately 4 hours per year) if operating 2 per cent of the time as anticipated; and 0.27 per cent (or about 24 hours per year) if operating at 12 per cent of the time
- The Proposal Site is very close to the northern side of Kurri Kurri township – and so could potentially be considered as part of the built-up area of the town and nearby facilities
- A risk assessment process has determined that the probability of risk and severity to aircraft is low, with the majority of hazard cases examined evaluated as being in the Acceptable range and all within an Acceptable Level of Safety. When factoring the probability of plume exceedances by the anticipated Proposal operating time (most likely expected up to 2 per cent in any given year) and maximum operating time sought (12 per cent), the risk to aviation is further reduced
- Suitable mitigation measures will not limit the use of the surrounding airspace and can be used to inform pilots of the location of the plume and to avoid overflight when operating
- Local stakeholders consulted with during the assessment agreed that the Proposal Site would not be problematic for local aviation, as long as pilots had a means of knowing the location of the Proposal Site and ideally when the power station was operating.

10.3.4 Mitigation measures

While the likely aeronautical activities impacting the Proposal are well defined, the Aeronautical Impact and Risk Assessment (Appendix G) noted that it is not possible to estimate the number or frequency of aircraft (of any type) flying in close proximity to the Proposal Site. While there are very low probabilities of risk to aircraft, the best form of mitigation in this case is to promote a situation whereby low overflight of the Proposal Site, especially at low speed, does not occur. The key mitigation measures recommended for the Proposal are outlined in Table 10.8. It should be noted that the proposed controls are intended to limit the number of aircraft in close proximity to the Proposal Site, so if any of the controls are implemented the number of aircraft overflying or in close proximity diminishes dramatically and can effectively be ignored. It is anticipated that CASA will accept the impact and risk assessment as documented, and the proposed control measures to reduce risk.

Table 10.8: Aeronautical mitigation measures

Reference	Mitigation measure	Timing
AV1	A suitable plume rise symbol will be published on relevant aeronautical navigation charts, to alert pilots to the potential for turbulence in airspace above the Proposal Site.	Operation
AV2	The ‘Additional information’ section in the ERSA Aerodrome pages for Maitland and Cessnock Airports will introduce notes and/or a diagram in respect of potential for turbulence in airspace above the Proposal Site.	Operation
AV3	The gas turbine exhaust stack structures will incorporate lighting that is to be activated when the power station is operating.	Operation

10.4 Electric and magnetic fields

10.4.1 Assessment methodology

The assessment of risk from exposure to electric and magnetic fields (EMF) associated with the Proposal has involved the review of design information and consideration of the Proposal Site and surrounding land-uses.

10.4.2 Existing environment

EMF are part of the natural environment. Electric fields are present in the atmosphere and static magnetic fields are created by the earth's core. EMF are also produced wherever electricity or electrical equipment is in use. Transmission lines, electrical wiring, household appliances and electrical equipment all produce power-frequency EMF. In contrast with natural EMF which are static, power-frequency fields oscillate at a frequency of 50 Hertz (Hz). EMF are strongest closest to the wires and electrical equipment and their level reduces with distance. The higher the voltage, the stronger the field.

As described in Section 1.4, the Proposal Site forms part of the former Hydro Aluminium Kurri Kurri aluminium smelter which operated from 1969 to late 2012 and was closed in 2014. There is an existing switchyard currently on the aluminium smelter site which will be fully decommissioned and demolished prior to Snowy Hydro starting construction for the Proposal. There is also existing 132 kV transmission lines adjacent to the Proposal Site. There nearest residences are on Dawes Avenue, Loxford, approximately 1.15 km south-east of the Proposal Site. The Kurri Kurri Speedway Club is on Dickson Road, Loxford, approximately 800 m south-east of the Proposal Site.

10.4.3 Impact assessment

Construction

There is no increase in risk to the public associated with exposure to EMF associated with the construction of the Proposal as no changes to the transmission lines or new sources of EMF will be generated. In fact, during construction there should be a reduction in the total EMF generated compared to that for the existing site, particularly as there will be periods where the existing 132 kV transmission lines will be non-operational.

Operation

As described in Section 2.2.7, the Proposal would connect into the National Electricity Market via a new 132 kV switchyard and the three existing Ausgrid operated 132 kV transmission lines. The transmission lines are currently in operation and connected into the existing Hydro Aluminium smelter switchyard, which will be decommissioned and demolished prior to construction of the Proposal. The new Proposal electrical switchyard will transfer the electricity produced at the power station to the regional electricity transmission and distribution system.

The proposed switchyard would introduce some EMF at the Proposal Site. All new electrical components are contained within non-publicly accessible areas. The Proposal may alter the EMF at the Proposal Site and the potential exposure to EMF would need to be considered for Snowy Hydro staff and contractors as part of health and safety management to ensure that it is managed to as low as reasonably practicable principles.

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) recommends compliance with the International Commission on Non-Ionizing Radiation Protection (ICNIRP) EMF guidelines. These guidelines protect against known adverse health effects and include a significant safety margin. Snowy Hydro complies with these guidelines for both the public and its workers.

The Proposal is not considered likely to restrict the types of development compatible with current or future zoning or likely future uses of the Proposal Site and its surrounds from an EMF risk point of view.

10.4.4 Mitigation measures

Recommended mitigation measures to reduce potential EMF impacts are outlined in Table 10.9.

Table 10.9: EMF mitigation measures

Reference	Mitigation measure	Timing
EMF1	Design and selection of all electrical equipment is to minimise EMF levels and comply with the International Commission on Non-Ionizing Radiation Protection (ICNIRP) reference levels.	Detailed design
EMF2	The health and safety aspects of potential exposure to EMF at the Proposal Site will be considered for staff and contractors as part of health and safety management practices.	Operation

11. Soils and contamination

The objective of this chapter is to assess the potential impacts of the Proposal on soils and contamination and outline proposed mitigation measures. In addition, the chapter discusses the risks that contamination associated with the former Kurri Kurri aluminium smelter may have for the construction and operation of the Proposal.

As described above, the Proposal Site forms a component of the former Kurri Kurri aluminium smelter site, a site which is owned by Hydro Aluminium and has been subject to considerable assessment and subsequent remediation of land contamination. The available information from this process has been beneficial to the Proposal, and provides a sound basis upon which to characterise potential contamination within the Proposal Site. Consequently, this information has been drawn upon, together with establishing land transfer and site auditing arrangements, to assess the extent and nature of contaminated materials on the Proposal Site.

The Former Hydro Aluminium Kurri Kurri Smelter Remediation and Demolition Project EIS (Ramboll Environ, 2016) indicates that there are contaminated soils and materials across the Kurri Kurri aluminium smelter site that have arisen during the operation of the smelter and will require remediation. Remediation of the Kurri Kurri aluminium smelter site project was declared State significant and the Secretary's Environmental Assessment Requirements required that a Remedial Action Plan (RAP) be prepared and that the RAP be accompanied by a Site Audit Statement from an Environment Protection Authority (EPA) accredited site auditor and prepared in accordance with the contaminated land planning guidelines under Section 145C of the EP&A Act and relevant guidelines produced or approved under Section 105 of the *Contaminated Land Management Act 1997* (CLM Act). The remediation works are currently underway. After the remediation has been validated, a Site Audit Statement and a Site Audit Report will be issued by an NSW EPA accredited site auditor that states that the land is suitable for the intended industrial land use.

A Site Audit Statement prepared by a site auditor in accordance with Part 4 of the CLM Act stating that the land to which the statement applies is suitable for the proposed use in accordance with the proposed Rezoning Master Plan for ReGrowth Kurri Kurri must be in place prior to Snowy Hydro taking possession of the Proposal site. The proposed zoning for the site is IN3 Heavy Industrial zoning. This means that prior to any construction, the Proposal Site is required to be remediated, and validated, by others. Therefore, no detailed investigations of existing water or soil contamination or any remediation measures are required as part of this Proposal.

11.1 Assessment methodology

The assessment of land and contamination for the EIS has relied upon the findings of the Hydro Kurri Kurri Aluminium Smelter Remediation project, to address the SEARs, assess the potential human health and environmental risks associated with the construction and operation of the Proposal, and to describe any measures that would be implemented to avoid or mitigate impacts.

The NSW EPA requested DPIE to consider including a provision in the SEARs requiring that a site auditor accredited under the CLM Act be engaged to provide a Section A Site Audit Statement and accompanying Site Audit Report certifying suitability of the land for the proposed land use. In carrying this out, the site auditor would review the adequacy of the investigations, and any remedial works or management plan required, and confirm suitability of the land for the proposed use.

This chapter addresses the SEARs and also takes cognisance of the NSW EPA request. In order to address the above, previous investigations and current and proposed remediation and validation processes being undertaken by others are outlined. These include considerable contamination and soils assessment programs which have been undertaken across the former Kurri Kurri aluminium smelter site over the past decade including:

- A phased series of Phase 1 and Phase 2 contamination assessment works
- Human Health Risk Assessments and Ecological Risk Assessments

- Supporting assessments for soils, groundwater, surface water, sediment characterisation and soil vapour, in accordance with NSW EPA Guidance documents, the EP&A Act, and relevant guidelines produced or approved under the CLM Act.

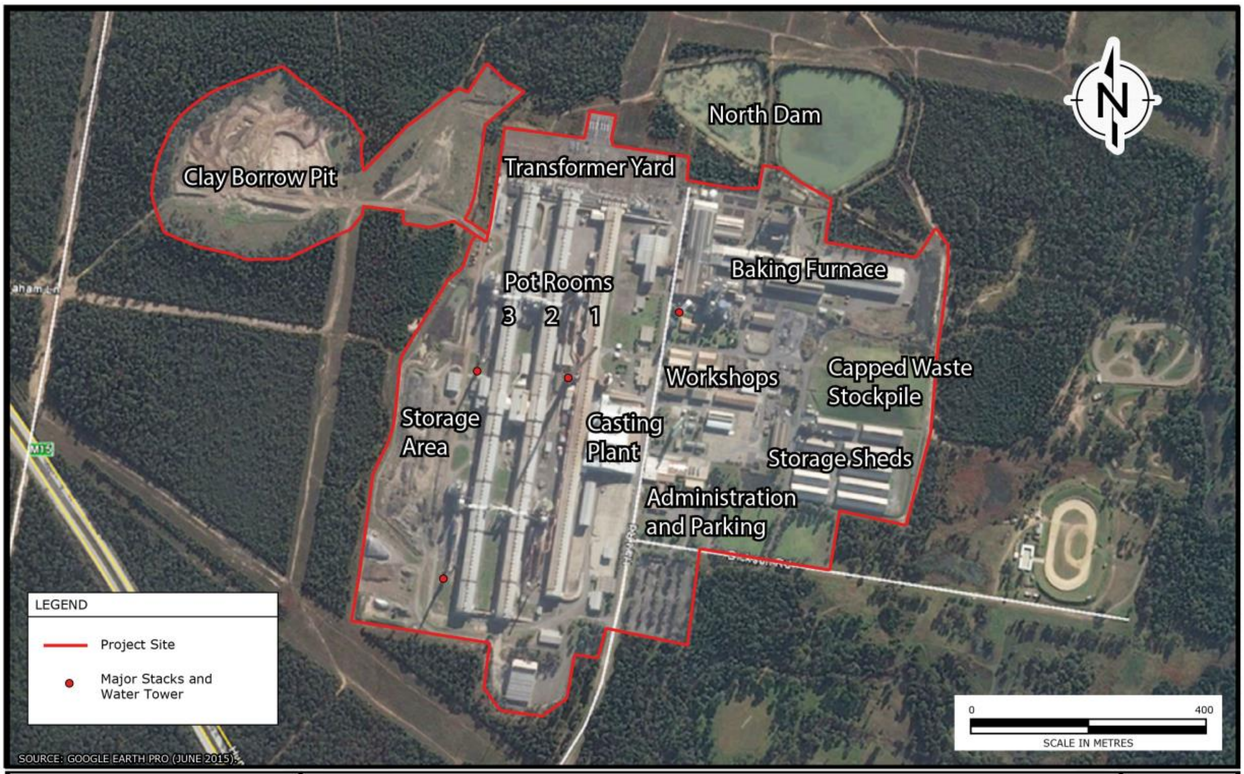
This assessment has also explored the Proposal's potential (unmitigated) construction and operation risks associated with contaminated sediment, surface water and groundwater.

11.2 Existing environment

The Proposal Site is heavily disturbed from previous aluminium smelter activities between 1969 and 2014. Historical operations at the Proposal Site have likely caused legacy contamination issues to soil, surface water and groundwater at several locations. Waste streams and contaminants associated with former operations include (among others): spent pot lining, cryolite, alumina, floor sweepings (alumina, cryolite, carbon), shot blast dust (carbon, steel shot), cement, pot lining mix, asbestos containing materials, coal tar pitch and small amounts of other materials including plastic, wood and steel.

The operational areas of the Kurri Kurri aluminium smelter site were filled historically to create a flat, elevated platform at approximately 14 m AHD. Landforms to the north and east of the site comprise low-lying swamps, with many surface water drainage ponds and creeks, interspersed with topographical rises comprising residual soils.

Stormwater on the smelter's paved areas was directed via conduits to either the West Pond, which is located on the western boundary of the operational area of the smelter or the East Pond, which is located on the eastern boundary of the smelter site (see Figure 11.1). Surface water runoff from the car park and administration areas is directed to the South Pond. All of the ponds flow or were pumped to the North Pond, located to the north of the Carbon Plant to the north east of the Proposal Site.



Source: Rambol 2018 EIS

Figure 11.1: Features of former smelter site

According to previous contaminated site investigations concerning the Kurri Kurri aluminium smelter, the south-west corner of the Kurri Kurri aluminium smelter site was used as a firefighting training area. There is no reference to firefighting foams that may have been used and which could have potentially contained per- and polyfluoroalkyl substances (PFAS). This area is not near the Proposal Site and it is unlikely that any PFAS runoff migrated to the Proposal Site via the stormwater drainage system.

Contaminants of potential concern relating to the production of aluminium and ancillary operations at the former Kurri Kurri aluminium smelter site include:

- Fluoride
- Cyanide
- Total Petroleum Hydrocarbons (TPH)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Aluminium
- Heavy Metals (As, Cd, Cr, Cu, Ni, Pb, Zn, Hg)
- Pesticides (Organochlorine Pesticides and Organophosphorus Pesticides)
- Asbestos
- Polychlorinated Biphenyls (PCBs)
- Per- and polyfluoroalkyl substances (PFAS).

11.2.1 Soils and geology

The Proposal Site is located on an alluvial flood plain that consists of a surficial layer of sand, gravel and finer material. The south western and western portions of the site are underlain by residual soils comprising silty clays derived from the weathering of the underlying bedrock, whereas the eastern and north eastern portions of the site are underlain by alluvial soils comprising silty clays, sands and gravels deposited by the Swamp Creek and Wentworth swamps alluvial systems. The thickness of the unconsolidated material ranges from approximately 3 m to 19 m. The alluvium unconformably overlies the regional bedrock, which is made up of the rock units of the Permian aged Dalwood Group of the Sydney Basin. The Dalwood Group coal measures are also known to subcrop/outcrop in the Cessnock region and historic underground coal mining has occurred within 3 km of the Kurri Kurri aluminium smelter site.

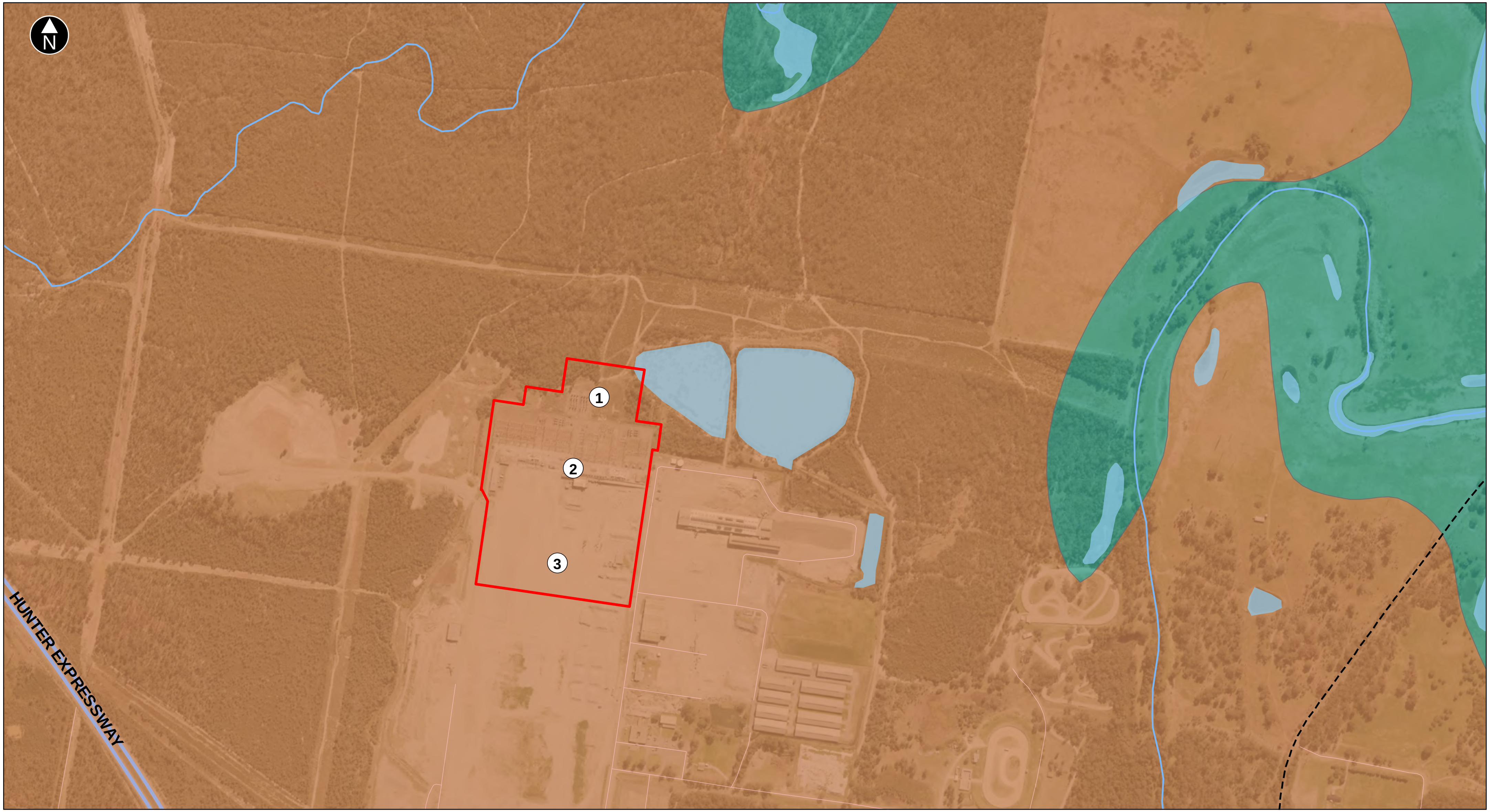
The following published information has been reviewed in the assessment of ground conditions at the Kurri Kurri aluminium smelter site:

- Singleton 1:250,000 Geological Series Sheet SI 56-1 (1st Edition - 1969)
- Cessnock 1:100,000 Geological Series Sheet 9132 (dated 1976)
- Singleton 1:250,000 Soil Landscape Series Sheet SI 56-1 (dated 1985).

Some modification has taken place to the natural landform, at the site of the former Kurri Kurri aluminium smelter, where filling has taken place to create a level area. Surface soils show some evidence for dispersive characteristics, with rilling and gullying evident with some exposed banks.

The published mapping (see Figure 11.2) indicates that soils below the Kurri Kurri aluminium smelter site belong to the Solidic Soils group. These soils are associated with undulating low hills and rises with many small creek flats, extending over a large area between Singleton and Cessnock and are derived from the in-situ weathering of the underlying bedrock. Podzolic and Soloth soils predominate (typically loamy sands and sandy loams with clay subsoils), which often exhibit dispersive characteristics. Soil depths are generally reported as being greater than 1 to 1.5 m.

The underlying bedrock is mapped as belonging to the Rutherford Formation (Pdar), which is Permian in age (see Figure 11.3). The Rutherford Formation is reported to comprise interbedded mudstone, conglomeratic sandstone, sandstone and shale. Quaternary alluvium (Q_av) is mapped as being present associated with Swamp Creek to the east of the site, as well as minor unnamed watercourses to the north and north-west of the Proposal Site. These alluvial sediments would be anticipated to comprise an interbedded and variable sequence of clays, silts and sands. There are no Acid Sulphate Soils mapped at the Proposal Site.



Proposal Site
Motorway
Roads
Railway
Hydroline
Waterbodies

Soils Group
ALLUVIAL SOILS
SOLODIC SOILS

1 Proposed Switchyard Area
2 Proposed Plant Area
3 Proposed Buffer Area

0 0.25 0.5 km

1:10,013 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs 2020
Metromap (Aerometrex) 2020
NSW Spatial Services
OEH

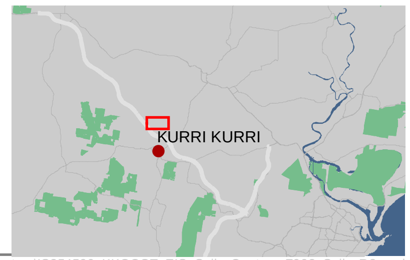
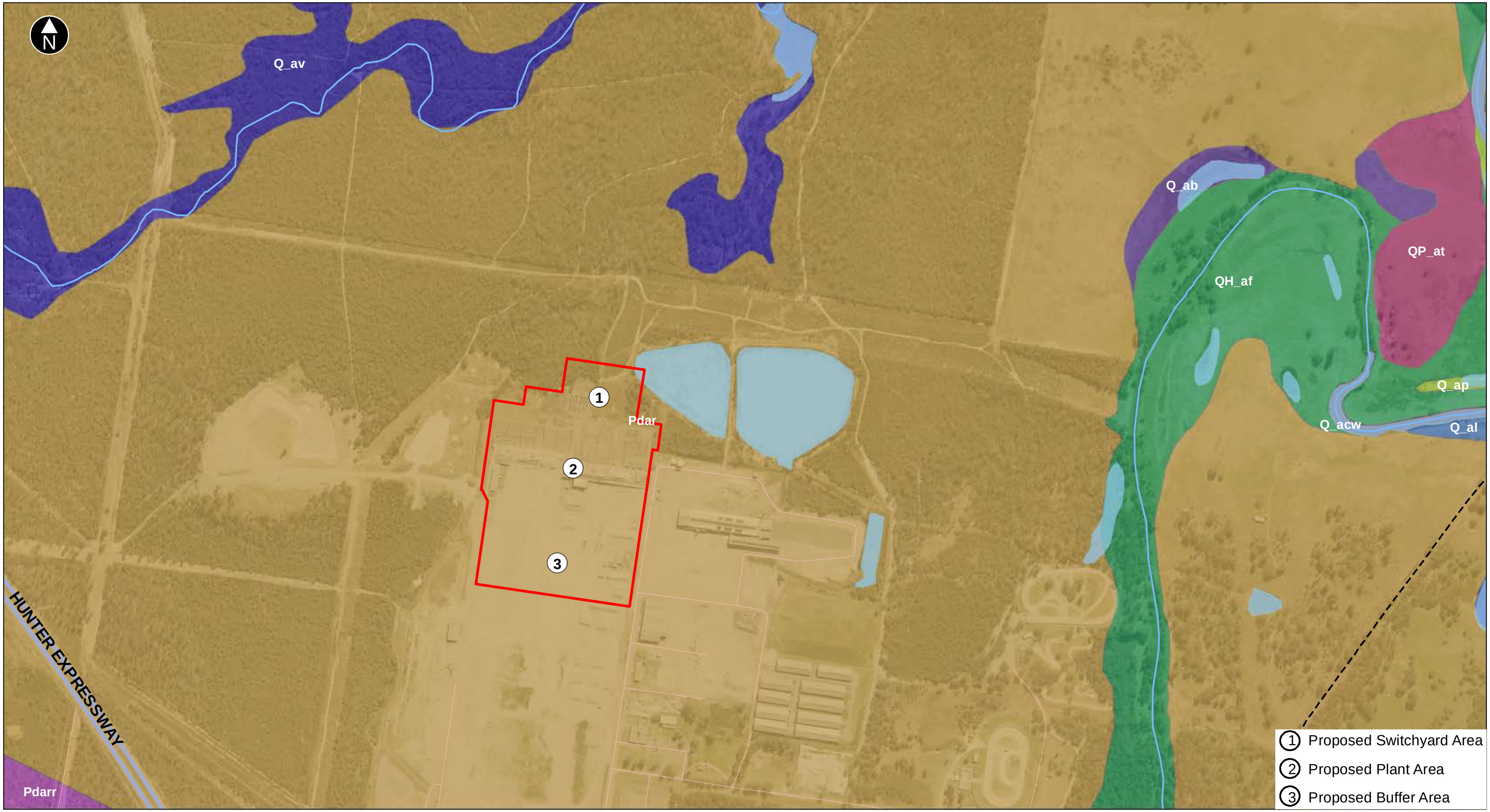


Figure 11-2 Soil landscapes

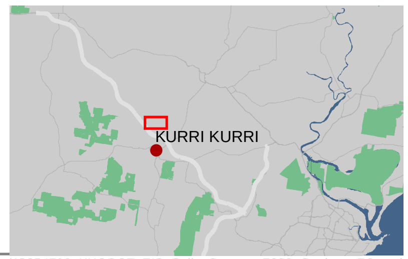


Proposal site
Motorway
Roads
Railway
Hydroline
Waterbodies

Geology - Unit_Name, NSW_CODE
Alluvial backswamp deposits:Q_ab
Alluvial channel deposits - subaqueous:Q_acw
Alluvial floodplain deposits:QH_af
Alluvial levee/overbank deposits:Q_al
Alluvial palaeochannel deposits:Q_ap
Alluvial terrace deposits:QP_at
Alluvial valley deposits:Q_av
Ravensfield Sandstone Member:Pdarr
Rutherford Formation:Pdar

0 250 500 m

1:10,000 at A4
Coordinate System: GDA2020 MGA Zone 56



Data sources:
Jacobs 2020
NearMap 2020
NSW Spatial Services
OEH

Figure 11-3 Geology

snowy hydro renewable energy Jacobs

Date: 5/03/2021 Path: \\Jacobs.com\ANZ\IE\Projects\04_Eastern\IS354500\22_Spatial\GIS\Directory\Templates\Figures\KurriKurriEIS\Specialists\Soils_Contam\IS354500_KKOCGT_EIS_Soils_Contam_F003_Geology_R2.mxd
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Dames and Moore (1992) describe the results of geotechnical investigations performed across the Kurri Kurri aluminium smelter site between 1966 and 1986. They indicate the south western and western portions of the Kurri Kurri aluminium smelter site as being underlain by residual soils comprising silty clays derived from the weathering of the underlying bedrock, while the eastern and north eastern portions of the Kurri Kurri aluminium smelter site are underlain by alluvial soils comprising silty clays, sands and gravels deposited by the Swamp Creek and Wentworth swamps alluvial systems. Sequencing and thickness of the alluvial soils underlying the Kurri Kurri aluminium smelter site are understood to be variable and complex, with the soil type changing significantly over relatively short distances both vertically and laterally; this is seen as a result of the nature of the deposition of the alluvial sediments in an alluvial environment where the river system is meandering and migrating across a floodplain.

11.2.2 Contamination Assessment Programs

A series of contamination assessment programs have progressively been undertaken across the former Kurri Kurri smelter site over the past dozen years, as part of the proposed demolition, remediation and re-purposing of the site. Considerable effort and systematic investigation of potential continuation issues have included historical land use studies, sampling and analysis programs for soil, sediment, surface water, groundwater and vapour matrices have been completed for the property, and reviewed as part of this EIS. The reports and assessment programs that are relevant and applicable to the contamination issues associated with the Proposal have been considered and reviewed and the relevant information summarised below.

Phase 1 Environmental Site Assessment (2013)

The Phase 1 Environmental Site Assessment (ESA) for the Aluminium Smelter (Environ, 2013) includes a review of historical aerial photographs from 1951 at intervals leading to 2013, site walk over; and a review of previous investigations undertaken by consultants. The following aerial photograph reviews are of most relevance:

- 1971 - 1:4000 Orthophoto map Series, Heddon Greta U4565-1: This orthophoto map shows the eastern portion of the smelter and the north eastern portion of the Buffer Zone. There are four dams visible between the smelter and Swamp Creek, most likely associated with farming and stormwater management.
- 1975 Historical Aerial Photograph: The main change since the 1971 aerial photograph is the construction of the smelter. Pot Line 1, the Carbon Plant and ancillary buildings are evident. The beginnings of a waste heap now known as the Alcan Mound is evident immediately east of the smelter (the Alcan Mound area is to the east and downgradient of the Proposal Site). Surface water drainage channels have been constructed on the eastern and western smelter perimeters to drain surface water into the surrounding smelter's Buffer Zone.
- 1978 Aerial Photograph: The photograph shows that the North Dam has been constructed. Additional surface water drainage channels have been constructed along the eastern and western smelter perimeters. The Alcan Mound has expanded and standing surface water (possibly leachate) is visible around the bunded edges. As the land along the western edge of the smelter was cut and filled to create a level platform to build additional pot lines, the creek located in this area was progressively relocated to the west.
- 1987 Aerial Photograph: The photograph shows the addition of the second and third pot lines, the Eastern and Western Ponds have been constructed and the Carbon Plant has been extended. A large volume of standing water (possibly leachate) is visible to the east of the Alcan Mound.

Other pertinent information from the Phase 1 ESA (Environ, 2013) includes statements that the transformers at the transformer/ switchyard area of the smelter site used to contain PCB-containing oils. The ERM (2000) Phase 1 report indicated that transformer oils containing PCBs were removed from site around 1990 and disposed of overseas. Replacement silicone oils were reported to be affected by residual PCBs.

Phase 2 Environmental Site Assessment (2015)

The Phase 2 Environmental Site Assessment (ESA), Kurri Kurri Aluminium Smelter report (Environ, 2015), was reviewed for site history and analytical data associated with the former operations across specified areas of the smelter site, with limited data and locations at the former transformer/switchyard area.

The Phase 2 ESA identified a risk of potential contamination at the former smelter's transformer/switchyard area, where transformer oils (spills and leaks) may have resulted in contamination by hydrocarbons and PCBs depending on the age of the facility. This location corresponds to Area 1 (proposed switchyard area) and Area 2 (proposed plant area) as shown in Figure 1.2.

The former Pot Lines 2 and 3 (now demolished) location lies partially within Area 2 (proposed plant area) and Area 3 (proposed buffer area), and holds potential contamination sources associated with dust deposition from the pot lines and PCBs in transformers from spills and leaks.

Analytical results for the single hand-augur sample collected in the north of the transformer/ switchyard site (SB20 (i) outside of the built area, but within the Area 1 (proposed switchyard area)) returned concentrations for potential contaminants of concern below the applied human health criteria for industrial site usage at this location.

Analytical results for two hand auger sample locations collected in the former Pot Line areas (SB4, within Area 2 (proposed plant area) and SB3, within Area 3 (proposed buffer area)) reported fluoride concentrations in shallow fill ranging from 13400 mg/kg and 41900 mg/kg from 0 m to 0.05 m depth. These results were in excess of the applied industrial criteria for soils.

Environmental Impact Statement (2016)

The Former Hydro Aluminium Kurri Kurri Smelter Demolition and Remediation Environmental Impact Statement (EIS) (Ramboll, 2016), describes the planning and approvals process, methods and mitigation measures associated with the demolition and remediation of the Kurri Kurri aluminium smelter site.

The EIS makes allowance for the disposal of non-recyclable/ non-reusable wastes generated during the smelter demolition and includes asbestos containing materials, contaminated sludge and dusts and contaminated building materials for disposal in the containment cell to the west of the Proposal Site. Figure 11.1 indicates the location of the containment cell that is being constructed (area shown as Clay Borrow Pit) by Hydro Aluminium for the remediation of the smelter.

Hazardous Materials Audit Stage 6 (2016)

Ramboll was engaged by Hydro Aluminium to undertake a Hazardous Materials Audit (Ramboll Environ, 2016b), which included the transformer yard (transformer/ switchyard), substations and miscellaneous areas. This report includes a Hazardous Materials Register identifying the type, location, condition and quantity of the hazardous materials, and an outline of the environmental, health and safety requirements to be implemented during their removal and handling. The register lists asbestos in switch rooms and most of the buildings on the transformer/ switchyard site. The register indicated that there appeared to have been oil leaks from the rectiformer equipment over many years and assumed that the underlying gravel and concrete had been affected. This was evidenced by staining on concrete in many areas across the (Hydro Aluminium transformer/switchyard) site.

Leaks and staining of bunding to transformer units north of the Pot Lines were observed. Transformer equipment throughout the area was identified as containing transformer oils, possibly containing PCBs. The audit indicated that there were possible oil leaks from transformer equipment within the transformer/switchyard area.

Substation Trial Assessment (2017)

The Kurri Kurri aluminium smelter site included a transformer/switchyard and 19 smaller substations. The substations were a potential source of soil contamination due to the leaking of transformer oil that contained petroleum hydrocarbons and may have contained PCBs. A remediation and validation trial was completed at one of the substations, 3CC, known to have previously contained PCBs in transformer oil (Ramboll Environ, 2017). The trial was completed to develop a methodology for the removal and segregation of potential PCB and hydrocarbon impacted materials (concrete, ballast and soil). The trial methodology also included the separation of visually stained concrete, ballast and soil from material with no staining.

Soil analytical results were compared against NEPM (2013) commercial/ industrial criteria and NSW EPA (2014) waste classification criteria. Based on the results of the trial, the following recommendations were made for the demolition, remediation and validation of the substations at the Kurri Kurri aluminium smelter site, including:

- Stained soil and ballast was found to contain concentrations of petroleum hydrocarbons and PCBs exceeding NEPM (2013) commercial/industrial criteria. It was recommended that stained soil and ballast be excavated for off-site disposal.
- It was recommended that stained soil and ballast be excavated to a nominal depth of 100 mm below areas where staining is evident to account for PCB/TRH contamination that is not visual.
- Stained concrete from substations could be stockpiled with stained soil and ballast material for offsite disposal.

Hydro Smelter Kurri Kurri Remedial Action Plan (2015/2018)

The Hydro Smelter Kurri Kurri Remedial Action Plan (RAP) (Ramboll, 2015/2018) was reviewed for known areas of contamination and contamination remediation recommendations for the operational site and associated surrounding non-operational areas.

The RAP describes the progressive demolition and remediation earthworks associated with the Kurri Kurri aluminium smelter area and an area known as the Clay Borrow Pit and the design, construction and operation of a Containment Cell (see Figure 11.1). The disposal of site materials during decommissioning and demolition was also considered when evaluating the remediation options, with the preferred option identified for soil being the relocation and consolidation of all contaminated soils and the contents of the Capped Waste Stockpile (Alcan Mound) in one specifically designed Containment Cell. This option was considered most favourable when compared to other options in terms of cost, risk of failure, long term legacy and onsite management, corporate responsibility and sustainability. The Containment Cell is being constructed at the location of the Clay Borrow Pit using best demonstrated available technology to contain contaminated soils and smelter wastes in perpetuity.

The Remedial Methodology (as detailed in the RAP) was as follows:

- Identify the extent of contaminated surface soils at each area of environmental concern (AEC) using site plans and global positioning system (GPS) information provided in the Phase 2 ESA reports
- Excavate contaminated surface soils from each AEC
- Transport contaminated soils to the designated stockpile area or directly to the Containment Cell
- Relocate contaminated soils from the stockpile area to the Containment Cell
- Validate soils remaining at each AEC
- Where required, re-instate each AEC with validated crushed concrete or refractory brick to appropriate site levels.

The RAP acknowledged that additional contamination assessment works were required at the site, including investigation of sediments and investigation of soil at the former transformer/ switchyard and substations. Any remedial works undertaken in the transformer/ switchyard area would require removal of all contaminated material from the site and validation of the remedial works to the satisfaction of an NSW EPA accredited auditor.

Hydro Aluminium Response to Submissions Report (2018)

The Hydro Aluminium Response to Submissions Report: Former Hydro Aluminium Kurri Kurri Smelter Remediation (Ramboll, 2018) includes a listing of AEC's and Potential AEC's. The existing transformer/ switchyard areas were included as AEC and Potential AEC respectively.

11.2.3 Smelter Site Remediation and Land Transfer Process

The Remediation Action Plan (2015/2018) indicates areas within the site to be remediated (Pot Lines and Dry Scrubbers) and areas not yet assessed due to restrictions (Transformer/switchyard).

The site auditor Interim Opinion (AECOM, 26 July 2016) indicates that further supplementary investigations are proposed in the Areas of Environmental Concern (AEC's) not yet able to be assessed due to access issues. The final land use suitability audit will require the entire Kurri Kurri aluminium smelter site to be characterised and, if necessary, remediated for the proposed land uses. This supplementary characterisation and remediation would need to include the parts of the smelter buffer land that are associated with the audit, and areas between the AECs, to ensure that the whole of the site (as defined) is able to be certified as suitable for the proposed uses and ongoing protection of human health and the environment is achieved.

The extent of the Kurri Kurri aluminium smelter site that will require remediation (and validation) is indicated in the RAP and noted in the Interim Opinion (above) and includes the Proposal Site.

The Site Audit Report (AECOM, 2018) associated with auditor review and sign-off of the RAP indicates the following:

- That a comprehensive Validation Plan for the smelter (Transformer/switchyard) be developed and endorsed by a Site Auditor prior to implementation of the remedial works - Supplementary investigations following gaining access after the proposed demolition works will confirm the type, nature and extent of contamination within the transformer/ switchyard and a detailed validation plan for each area will then be developed.
- That a further Site Audit be completed to verify the successful implementation of the 2018 RAP and confirm the land use suitability - These standard requirements are per Part IV (Explanatory Notes) to the Site Audit Statement Form.
- Some parts of the smelter site are subject to supplementary investigations (such as the transformer/ switchyard) once access is provided as a result of the staged demolition program. Once the supplementary investigations have been completed, an Environmental Management Plan (EMP) for the remedial works may be prepared for auditor endorsement.
- That a final risk assessment is performed at the completion of the remedial works currently proposed, to ensure that human health and environmental risks have been adequately addressed.
- The 2018 RAP concludes that the remedial approach should result in a site that does not pose any unacceptable risk to human health and the environment, but notes an uncertainty in the potential groundwater risk following "source removal". The Consultant (Ramboll) concludes that a final risk assessment would be warranted to confirm that no unacceptable risk remained.

The land transfer process from Hydro Aluminium and the Developer of the industrial estate to Snowy Hydro, includes a provision that a Site Audit Report is issued by a NSW EPA accredited contaminated land auditor, stating that the remediated and validated land (both above and below ground) where the Proposal would be constructed and operated, is suitable for its intended use under a IN3 Heavy Industrial land use zoning.

11.3 Impact assessment

11.3.1 Construction

The Site Audit Statement prepared by a site auditor in accordance with Part 4 of the CLM Act stating that the land to which the statement applies is suitable for the proposed use in accordance with the proposed Rezoning Master Plan for ReGrowth Kurri Kurri must be in place prior to Snowy Hydro taking possession of the Proposal Site. This means that prior to any construction, the Proposal Site is required to be remediated by Hydro Aluminium or the Developer of the industrial estate. Land remediation protocols require verification of outcomes through an EPA site audit statement, which would be prepared by an EPA accredited site auditor prior to the remediated site being handed back to the owner by the remediation contractor.

Given that the Proposal Site will be remediated and validated by others to the satisfaction of an independent NSW EPA accredited contaminated land auditor and the NSW EPA prior to Snowy Hydro taking possession of the Proposal Site, the Proposal will give rise to negligible risk to human health or the environment due to exposure to legacy contamination.

The remaining potential impacts upon topography, soil and geology have been considered as having potential to occur during construction of the Proposal:

- Risks associated with soil erosion during the earthworks associated with site regrading, the stormwater basin, foundation excavation and services installation
- Construction of the Proposal would also involve the storage, treatment or handling of fuels, chemicals, building materials, wastes and other potential contaminants. Potential for chemical and fuel spills during construction may result in localised contamination of soils and/or groundwater.

The proposed stormwater basin that will serve to manage water quality and sediment during construction and suite of construction measures described in Chapter 13 will also effectively address most of the risks to soils, surface and groundwater and hence are not repeated here in the mitigation measures below.

11.3.2 Operation

General operation of the Proposal may result in incidental spills or leaks as a consequence of plant or equipment malfunction, maintenance or refuelling. Accidental spills may also occur as a result of inappropriate storage, handling and use of plant and equipment (including vehicles on-site). While there is potential for spills and leaks, the design of the Proposal would include bunds, handstand and other means to prevent seepage to soils and groundwater.

Snowy Hydro power stations utilise oil containment and separation systems with three layers of protection including drainage pits, oil skimmers and oil water separators prior to discharging station water to the environment under approved license agreements.

Snowy Hydro has developed and implemented a rigorous system to manage all operational and day-to-day activities across all of their assets and this system will also be implemented at the Proposal. The Snowy Hydro Environmental Management System (EMS) has been in place since June 2000, integrating environmental risk assessment and legal compliance management across all Snowy Hydro assets. It also provides the framework for learning and improving through an incident management system. It ensures that Snowy Hydro operations meet environmental commitments by:

- Setting clear direction through the Environment Policy and Objectives
- Identifying environmental risks and legal obligations
- Putting in place effective operational controls
- Checking and correcting ongoingly
- Reviewing and updating policies and procedures.

Snowy Hydro has put in place an incident management system to manage unplanned events and learn from them. The critical elements of incident management include early communication, classification of seriousness, thorough investigation and effective implementation of actions to ensure that any harm is corrected and lessons are learnt with a view to preventing future incidents. The Snowy Hydro EMS and operational procedures are proven across all other Snowy Hydro assets and these systems would be effectively applied to the operation of the Proposal.

11.4 Mitigation measures

Measures to avoid, minimise or manage contamination during construction and operation of the Proposal are detailed Table 11.1.

Table 11.1: Recommended environmental management and mitigation measures

Reference	Environmental Management Measure	Timing
CLM01	A hazardous materials and spill management plan will be prepared as a sub-plan of the CEMP. It will outline requirements relating to the storage of fuels and chemicals, waste management, as well as training and procedures for incident and spill response.	Construction
CLM02	Contamination risks during operation would be managed through the application of relevant standards for the storage and handling of fuels and chemicals and appropriate engineering design.	Operation
CLM03	Snowy Hydro's Environmental Management System operational controls and procedures, and the Environmental Standards Handbook and associated training and inductions, will be implemented for all site activities having the potential to release contaminants into the environment.	Operation

12. Groundwater

A groundwater impact assessment report was prepared to address the SEARS requirements for the Proposal. The SEARS relevant to this assessment required an assessment of the impacts of the project on groundwater aquifers and groundwater dependant ecosystems. Groundwater Impact Assessment presents the Groundwater impact assessment report. A summary of the groundwater impact assessment report is presented in this chapter.

12.1 Assessment methodology

The groundwater impact assessment involved a review of existing groundwater conditions around the Proposal Site to assess the likely potential impacts of the Proposal on groundwater. The assessment involved:

- Desktop study of existing hydrogeological conditions and review of groundwater quality information at the Proposal Site to understand the existing environment and identify potential impacts
- A review of available literature and relevant previous investigations, including:
  - Environmental Impact Statement, Former Hydro Aluminium Kurri Kurri Smelter Demolition and Remediation (Ramboll Environ, 2016)
  - Phase 2 Environmental Site Assessment, Kurri Kurri Aluminium Smelter (Environ, 2012).
- A review of WaterNSW records indicating the presence of 17 existing groundwater bores at or near the Proposal Site. Further assessment included:
  - A bore census to confirm the location of the identified bores and record total depth and depth to standing water level
  - Groundwater quality assessment of six groundwater bores.
- Assessment of potential dewatering requirements and associated drawdown impacts due to construction and dewatering and any proposed ongoing water take associated with the Proposal.

12.2 Existing environment

12.2.1 Topography and surface water features

The Proposal Site and its surrounds are primarily flat with an elevation of approximately 14 m AHD. Natural drainage flows towards the north-east towards Black Waterholes Creek. Two artificial ponds, located north-east of the Proposal Site, were constructed to capture stormwater runoff from the former aluminium smelter site and are integrated with the natural drainage regime. In addition to evaporation, water from the ponds was also irrigated on an adjacent paddock located further to the north east. Land further east and north of the Proposal Site comprises low-lying open rural land, and the waterways of Swamp Creek, Black Waterholes Creek and the Swamp Creek wetlands, which are part of the extensive Hunter River floodplain.

12.2.2 Geology and soil landscapes

The Proposal Site was raised by localised cut and fill activities and was heavily disturbed due to the construction of the aluminium smelter on parts of the land, which included widespread foundations and footings extending to depths of more than 1.5 m. Extensive, staged demolition and remediation works are currently under way and would be completed before Snowy Hydro takes possession of the Proposal Site.

A geotechnical review and intrusive investigation indicated deep alluvial soils across the Proposal Site, with siltstone bedrock identified at depth of approximately 14 m to 18 m. Laboratory testing of near surface soils indicate that the soil is sodic and hence, potentially dispersive in nature.

Acid Sulphate Soils (ASS) are considered unlikely to be present at the Proposal Site according to NSW Department of Planning and Environment (DPE) planning maps (2019) (refer Figure 12.1).

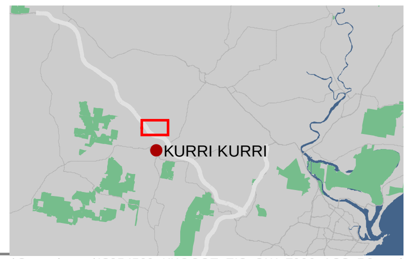
Proposal Site
Motorway
Main roads
Roads
Railway
Waterbodies

Acid Sulphate Soils Risk Class
Class 2
Class 3
Class 4

1 Proposed Switchyard Area
2 Proposed Plant Area
3 Proposed Buffer Area

0 250 500 m

1:12,000 at A4
Coordinate System: GDA2020 MGA Zone 56



Data sources:
Jacobs 2020
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 12-1 Acid Sulphate Soils

snowyhydro renewable energy Jacobs

Date: 5/03/2021 Path: \\Jacobs.com\ANZ\IE\Projects\04_Eastern\IS354500\22_Spatial\GIS\Directory\Templates\Figures\KurriKurriEIS\Specialists\Groundwater\IS354500_KKOCGT_EIS_GW_F006_ASS_R2.mxd
Created by : AA | QA by : GS

However, laboratory testing indicated a possible risk of ASS in the alluvial soils at depth. Given the relatively shallow depths of the proposed excavations, ASS disturbance is considered unlikely. Further details of soil conditions and underlying geology at the Proposal Site are provided in Chapter 11.

12.2.3 Groundwater features

The underlying hydrogeology at the Proposal Site is understood to comprise two groundwater systems, a shallow alluvial aquifer which is understood to connect to surface water in Swamp Creek and Black Waterholes Creek, and a deeper bedrock aquifer, in siltstone and weathered sandstone beneath the alluvial layers.

There are 31 groundwater monitoring bores in the vicinity of the Proposal Site, identified in a bore census undertaken in November 2020 (see Figure 12.2).

The investigations conducted during the preparation of this EIS, in respect of groundwater levels, flows, quality, sharing and use, are summarised in the following section.

Groundwater levels and depth

The depth to the water table in the vicinity of the Propose Site ranges from about 1 m below ground level (bgl) to about 8 m bgl, with most locations observed ranging from 1 m to 3 m bgl. The shallower observations were along the eastern boundary of the Proposal Site, while the deeper observations were made along the western boundary. Geotechnical drilling undertaken for the Proposal did not confirm whether this was indicative of the local groundwater table or anomaly perched features within fill material. Given the high rainfall in the months preceding the geotechnical drilling, it is considered likely that the observed water was temporarily saturated fill material perched above the local groundwater table.

Existing site infrastructure such as stormwater drains have potentially lowered the water table at the Proposal Site. Existing stormwater retention ponds and associated groundwater mounds are considered to be a potential source of groundwater recharge, and potentially groundwater contamination.

Groundwater flows

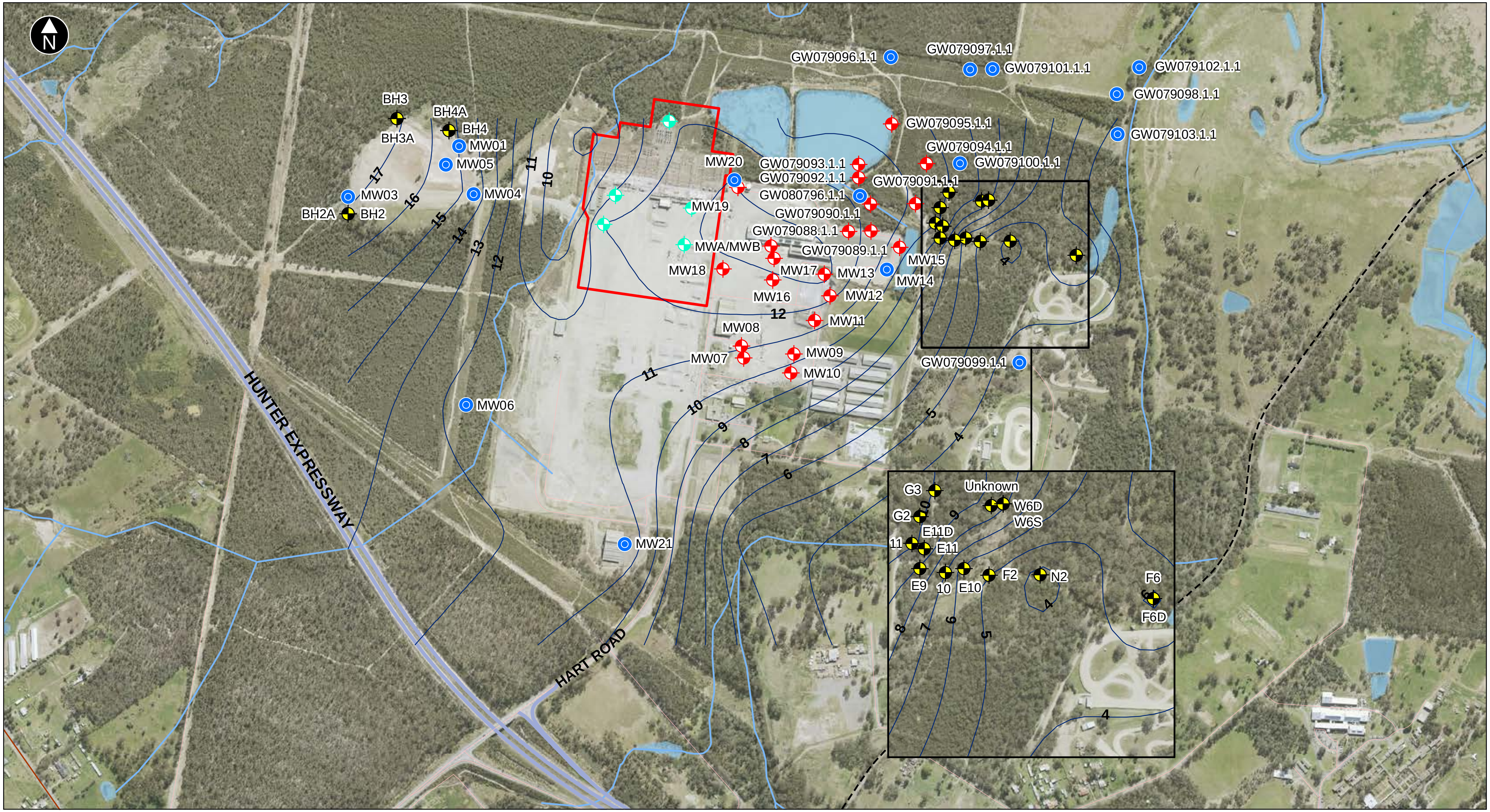
The dominant regional groundwater flow direction is generally to the north and north east toward sensitive receptors such as Wentworth Swamp, Black Waterholes Creek and the Hunter River. Beneath the Proposal Site, groundwater flow is inferred to be predominately west-north-west toward the unnamed tributary of Black Waterholes Creek, while an easterly groundwater flow direction is present to the east of the Proposal Site.

Groundwater dependent ecosystems and sensitive receiving environments

There are no groundwater dependent ecosystems (GDE) identified within the Proposal Site. The nearest GDE is a terrestrial GDE with moderate potential for groundwater interaction approximately 250 m west and north of the Proposal Site as shown in Figure 12.3. Wentworth Swamp, located approximately 2 km north-east of the Proposal Site, is identified as a high potential GDE (Coastal Freshwater lagoon). A number of nearby sensitive receiving locations have been identified, including Wentworth Swamp, Black Waterholes Creek and the Hunter River. These areas host identified GDEs or have a high likelihood of hosting GDEs or water dependant riparian vegetation.

Groundwater quality

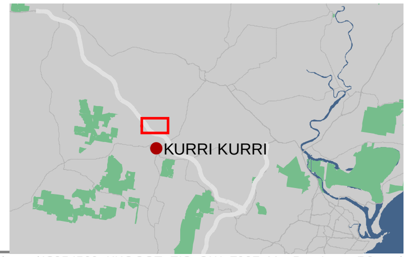
Previous industrial activities adjacent to the Proposal Site have impacted groundwater quality, primarily via stormwater ponds and waste storage areas, through contaminants leaching into soils and groundwater. Stormwater has also been irrigated onto adjacent bushland north of the stormwater ponds.



Proposal Site
Motorway
Main roads
Roads
Railway
Waterbodies
Monitoring bores locations to be sampled
Existing monitoing bore locations
Unregistered bores
Geotech boreholes
Groundwater level contours (mAHD)
Hydroline

0 250 500 m

1:12,000 at A4
Coordinate System: GDA2020 MGA Zone 56



Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 12-2 Monitoring bore locations

Proposal site
Motorway
Main roads
Roads
Railway

Terrestrial GDE
High potential GDE - from regional studies
Low potential GDE - from regional studies
Moderate potential GDE - from regional studies
Aquatic GDE

0 500 1000 m

1:30,000 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs 2020
Bureau of Meteorology 2020
NearMap 2020
NSW Spatial Services

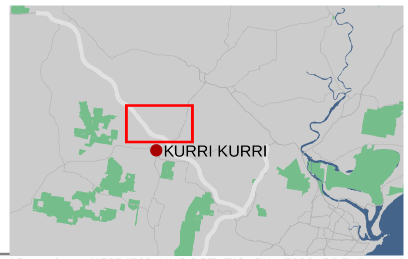


Figure 12-3 Groundwater dependent ecosystems (GDE)

Date: 3/03/2021 Path: J:\IE\Projects\04_Eastern\IS354500\22_Spatial\GIS\Directory\Templates\Figures\KurriKurriEIS\Specialists\Groundwater\IS354500_KKOCGT_EIS_GW_F008_GDE_R1.mxd
Created by : AA | QA by : GS

snowy hydro renewable energy Jacobs

Five selected monitoring bore locations (MW06, MW13, MW20, MW21, GW079099; refer Figure 12.2) around the Proposal Site were sampled in November 2020. Groundwater quality (major anions, pH, electrical conductivity) was analysed from samples, and a summary of the results is provided in Table 12.2. Field results and laboratory analysis can be found in Appendix H. The analysis showed high variations in water quality, with the key observations being:

- Electrical conductivity results ranged from slightly brackish (MW20 and MW13) (1,219 to 1,610 µS/cm) to saline (GW079099, MW21 and MW6) (14,100 to 20,700 µS/cm). The samples are all from similar depth and it is inferred that the reduced salinity at MW20 and MW13 may be due to locally enhanced rainfall infiltration or possibly due to seepage from existing site stormwater drains
- Groundwater appears to range from acidic to near neutral with measurements of pH ranging from 4.84 to 7.08
- Elevated sulphate levels at MW13 and MW20 may be indicative of historical contamination, or of the influence of acid sulphate soils.

Table 12.1: Groundwater quality sample results

Monitoring Bore	Salinity (µS/cm)	pH
MW6	20,700	6.65
MW13	1,610	4.84
MW20	1,219 (1)	6.76
MW21	19,900	7.08
GW079099	14,100	5.65

Notes:

1. Field reading

Local groundwater resource and users

A search for private water bores indicated no registered bores for domestic or agricultural use within 3 km of the Proposal Site. The aquifer resource potential of the alluvial aquifer would be low to moderate. The aquifer resource potential for the bedrock aquifer would be low due to its siltstone geology.

12.3 Impact assessment

12.3.1 Construction

The unconfined aquifer underlying the Proposal Site is primarily recharged through rainfall. Therefore, altered surface water runoff from vegetation clearing, installation of site drainage and increase in impervious surfaces may potentially impact the local groundwater level during construction. This impact will also continue throughout the operational period but is predicted to be minimal and not extend much beyond the Proposal Site. Impacts on groundwater quality may also arise from spills and leaks of temporary storage and handling of fuels, oils and chemicals. Groundwater also has the potential to become contaminated by spills or leaks of oil and fuel from construction equipment.

Impacts to groundwater during construction may also arise due to excavation. Most of the components of the Proposal including the installation of underground services would require relatively shallow excavation in the order of approximately 0.3 m to 1.0 m which would not impact groundwater. It is expected that the gas turbine and generator foundations would involve more substantial excavations up to depths of approximately 1.8 m and bored piles into bedrock (up to a maximum of approximately 18 m depth). A stormwater basin north of the Proposal site would require excavations of approximately 3.0 to 3.5 m bgl, while excavation of various drainage pits and below ground tanks or sumps may also intercept the local groundwater table.

Figure 12.4 shows the interpreted depths for two scenarios of excavation and groundwater depths from a west to east transect of the Proposal Site. The diagram indicates that most of proposed excavations would unlikely intercept the groundwater table. It is likely that excavations on the eastern portion of the Proposal Site would intercept the groundwater table, or shallow perched features within the fill material. If groundwater is encountered in natural formations, significant inflow is unlikely, and dewatering is not expected due to the limited depth of excavations and low permeability of the alluvium. If perched groundwater features are encountered within fill material, there may be some temporary inflows. Groundwater drawdowns would be very localised and confined to the Proposal Site.

Excavation for the proposed stormwater basin at the northern boundary of the Proposal Site may result in some minor localised groundwater recharge. No material impacts are anticipated for other groundwater users or environmental values due to the localised changes in groundwater levels.

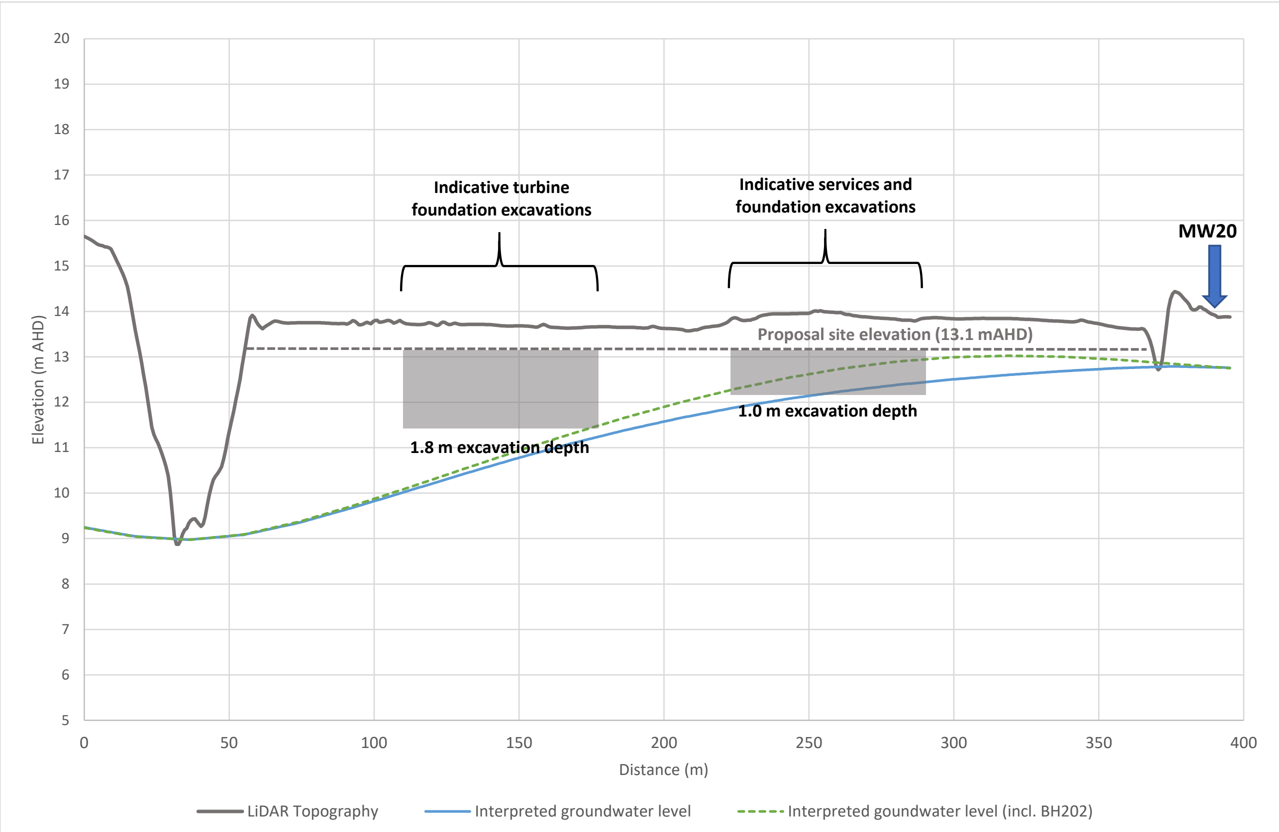


Figure 12.4: Indicative depths of excavations and groundwater (two scenarios)

NSW Aquifer Interference Policy minimum impact considerations

Based on the *NSW Aquifer Interference Policy* classification, the alluvial water source at the Proposal Site is considered locally as a less productive water source. This is primarily due to the higher salinity and low permeability of sediments compared to local water sources. During the construction phase, the level one minimum impact considerations of the *NSW Aquifer Interference Policy* (Department of Primary Industries, 2012) would be met, as summarised in Table 12.2.

Table 12.2: Assessment against *NSW Aquifer Interference Policy* minimal impact considerations

Water source	Assessment
Alluvial Water Source Alluvial Less productive	**Water table:** ▪ Meets level one consideration with respect to drawdown at High Priority GDEs and water supply works. ▪ No significant drawdown is anticipated to occur at High Priority GDEs or water supply works. **Water pressure:** ▪ Meets level one consideration with respect to pressure head at water supply works. ▪ No significant drawdown is anticipated to occur at water supply works. **Water quality:** ▪ Meets level one consideration with respect to water quality. ▪ No reduction in beneficial use of the alluvial water source is anticipated to occur greater than 40 m from the Proposal Site. ▪ The project construction is not anticipated to result in an increase in the long-term average salinity of the alluvial water source.

12.3.2 Operation

The Proposal is anticipated to be in operation in late 2023. Groundwater reserves in the vicinity of the Proposal Site may experience reduced levels of recharge as impervious surfaces increase. However, these impacts are expected to be insignificant due to the existing clay soil types underlying the Proposal Site.

Contamination of groundwater may occur during operation due to spills or leaks. However, the design would incorporate features such as impervious bunded areas for all storage and handling of fuels, oil or chemicals, and to contain leaks of oil and fuel from machinery or refuelling activities. Areas of the Proposal Site that are sealed, as well as the stormwater capture and treatment system, would significantly reduce these impacts. Proposed stormwater treatment (subject to detailed design) includes an oil water separator and stormwater detention basin to further improve the quality of all stormwater discharged from the Proposal Site. Use of a stormwater detention basin may result in minor localised groundwater recharge which would reduce over time and is not expected to result in contamination of the groundwater.

A permanent water quality basin represents the most common and accepted means of ensuring that pollutant loads post development are reduced so that they are not higher than pollutant loads prior to development. However, where there is limited space, unsuitable topography, contaminated soils or groundwater, other constraints or owner/operator preferences, it would be possible to adopt other water sensitive urban design alternatives that achieve similar levels of pollutant load reductions. These alternatives range from measures to increase stormwater infiltration (porous pavements, vegetated swales, sand filtration pits, rainwater tanks for reuse) to various forms of on-site water quality treatment controls (gross pollutant traps, cartridge filtration).

NSW Aquifer Interference Policy minimum impact considerations

During the operational phase, no groundwater impacts are anticipated and as such, the project meets the level one minimal impact considerations of the *NSW Aquifer Interference Policy*.

12.4 Mitigation measures

This section presents a summary of recommendations to mitigate potential groundwater impacts during the construction and operation of the Proposal. Mitigation measures are outlined in Table 12.3.

Table 12.3: Groundwater mitigation measures

Reference	Mitigation measure	Timing
GW1	The Construction Environmental Management Plan for the Proposal will address temporary storage and handling of fuels, oils and chemicals, including a Spill Response Plan.	Construction
GW2	Subject to the outcomes of further geotechnical and groundwater investigations across the site to during detailed design, a dewatering procedure is to be prepared and implemented in the event of excavations encountering perched or shallow groundwater. These detailed design investigations are to also inform the need for excavation methods to address groundwater inflows, if necessary.	Detailed design, Construction
GW3	Excavation activities will implement testing and management procedures for potential ASS. The procedures will be set out in an ASS management plan, which will be prepared during detailed design.	Construction
GW4	The Operational Environment Management Plan (OEMP) for the Proposal will include preparation and implementation of a Spill Response Plan that addresses storage and handling of fuels, oils and chemicals.	Operation

13. Surface water and aquatic ecology

The purpose of this section is to assess the potential impacts to surface water quality and aquatic ecology from the construction and operation of the Proposal. This chapter summarises a detailed investigation and assessment of surface water quality and aquatic ecology, which was undertaken in respect of the Proposal and which is attached to the EIS as Appendix J.

13.1 Assessment methodology

The methodology for assessment of potential surface water quality and aquatic ecology impacts arising from the Proposal broadly includes:

- Desktop review and analysis of existing surface water quality information to understand the existing environment and identify potential waterway-specific risks
- Field assessment including collection of surface water grab samples and aquatic habitat assessment at nominated sites within the study area to support and enhance findings of the desktop analysis and refine the understanding of potential issues
- A qualitative assessment of the quality and quantity of pollutants that may be introduced during construction and operation of the Proposal, and the impact that this may have on surface water quality (with reference to the ANZG (2018) *Water quality Guidelines* and with regard to relevant environment values as identified in the DECCW (2006) *NSW Water Quality and River Flow Objectives)*
- Recommendations for appropriate treatment measures to mitigate the impacts of construction and operation of the Proposal on surface water quality and aquatic ecosystems.

The study area comprised the Proposal Site and a 500 m buffer around the Proposal Site. In addition, Black Waterholes Creek and Swamp Creek (which form part of Wentworth Swamp) have also been considered in the surface water and aquatic ecology assessment despite their location being outside the nominated study area as they are important downstream waterways with potential to be impacted by Proposal activities.

13.1.1 Desktop assessment

The desktop assessment involved a review of existing surface water and aquatic habitat conditions across the study area to assess the likely and potential impacts of the Proposal on surface water quality and aquatic ecology during the construction and operation phases. The review of information included a review of available literature, water quality data, background information on land use and information about the design and operation of the Proposal. Information sources included:

- Bionet – the Atlas of NSW Wildlife Threatened Species Profile Database (EESG, 2020) (accessed December 2020), which was searched for records of Commonwealth and state listed aquatic flora and fauna within a 10-kilometre radius of the Proposal footprint
- Atlas of Living Australia (ALA, 2020) (accessed December 2020), which was searched for records of Commonwealth and state listed aquatic flora and fauna within the study area
- KFH Mapping (DPI, 2007) and threatened species distribution maps (DPI, 2016) (accessed December 2020) available on the NSW Fisheries website, which were examined for the potential presence of threatened species in the study area
- 2015 Annual Environment Report – Hydro Aluminium Kurri Kurri Smelter (Hydro Aluminium, 2015)
- 2016 Annual Environment Report – Hydro Aluminium Kurri Kurri Smelter (Hydro Aluminium, 2016)
- 2017 Annual Environment Report – Hydro Aluminium Kurri Kurri Smelter (Hydro Aluminium, 2017).

13.1.2 Field assessment

Water quality samples and aquatic habitat assessments were undertaken at nominated sites within the study area on 12 November 2020. Nominated water sampling sites were chosen on natural waterways with the potential to be impacted by the Proposal, and at locations which corresponded closely to the previously sampled sites undertaken by the Hydro Aluminium Kurri Kurri Pty Ltd (Hydro Aluminium) surface water monitoring program (see Appendix J). This approach aides the data collected by ensuring grab sample data was comparable with previously available data.

Aquatic habitat was assessed against criteria outlined in the *Policy and Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) and *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003), whereby assessment sites have been classified into KFH "Type" and waterway "Class".

Water quality sampling was carried out where sufficient water was present. Sampling depth was recorded as well as in-situ water quality parameters including temperature, conductivity, salinity, pH and dissolved oxygen were measured using a calibrated YSI Pro Plus multi-parameter water quality meter. Turbidity was also measured in situ using a Hach turbidimeter. For each parameter measured in situ, three replicate measurements were recorded about 10 m apart. Each parameter was then recorded as the average (arithmetic mean) of the three measures.

Grab samples were also collected and sent to a National Association of Testing Authorities (NATA) accredited laboratory for analysis. The analytical suite for laboratory analysis included:

- Dissolved metals (aluminium, boron, cadmium, chromium, copper, lead, mercury, nickel, and zinc)
- Oxidised nitrogen (NO_x)
- Total Kjeldahl Nitrogen (TKN)
- Total nitrogen (TN)
- Total phosphorus (TP)
- Filterable reactive phosphorus (FRP)
- Dissolved major cations (Ca)
- Fluoride (F)
- Total and free cyanide (free CN).

13.1.3 Data analysis

Historic water quality data that was readily available included three years of monitoring data (2015 to 2017), collected during a surface water monitoring program undertaken by Hydro Aluminium as a condition of their Environment Protection License (EPL) that was held for the Hydro Aluminium, aluminium smelter operations and decommissioning. Monitoring sites were located across the Hydro Aluminium site and encompassed the creek systems of Wentworth Swamp, ephemeral ponds located on the surrounding land owned by Hydro Aluminium and catchment dams located between 2 km and 7 km from the aluminium smelter site.

Monitoring results were reported annually by Hydro Aluminium in annual environmental monitoring reports (Hydro Aluminium, 2015; Hydro Aluminium, 2016; Hydro Aluminium, 2017) and were compared against ANZECC/ARMCANZ (2000) (now ANZG, 2018) water quality guideline limits for stock watering (fluoride only), irrigation (pH and fluoride), and aquatic ecosystems (pH, conductivity and free cyanide).

The methodology for determining water quality exceedances included:

- Collating water quality data into a spreadsheet
- Calculating summary statistics for each site including number of samples, mean, median, maximum and minimum value
- Reporting compliance of the median (mean was used for sampling data) data with water quality objectives and ANZG (2018) default guideline values.

13.2 Existing environment

13.2.1 Catchment and waterways overview

The Proposal Site is situated in the Hunter River catchment which drains a total area of about 22,000 square kilometres (EPA, 2013). The Hunter River flows in a south-westerly direction from Glenbawn Dam in the Liverpool ranges to meet Goulburn River near Denman. From Denman, the river flows generally in a south-easterly direction through Singleton and Maitland to the north of the Proposal Site before reaching the Tasman Sea at Newcastle (DIPNR, 2004). Elevations across the catchment vary from over 1,500 m above sea level in the mountain ranges, to less than 50 m above sea level on the floodplains of the lower valley. Four major rivers discharge into the Hunter River along its length – these are Pages River, Goulburn River, Williams River and Paterson River.

The Proposal Site is located in proximity to three waterways, these include:

- Swamp Creek, which is a perennial waterway that flows south to north and is located about 900 m east of the Proposal area at its nearest point
- An unnamed tributary of Black Waterholes Creek, which is an ephemeral waterway that flows generally south west to north east. The tributary of Black Waterholes Creek is immediately adjacent to the Proposal Site on the western boundary
- Black Waterholes Creek, which is a perennial waterway, located downstream of the tributary and subsequently flows into Swamp Creek about 1.5 km downstream. Black Waterholes Creek is located about 800 m north of the Proposal Site at its nearest point.

All three waterways eventually converge to Swamp Creek which continues flowing north and drains a large network of low lying, floodplain environments known as Wentworth Swamp. Swamp Creek ultimately flows into Wallis Creek about 10 m downstream of the Proposal Site and Wallis Creek joins to the Hunter River a further 7 km downstream.

Other important water features within the study area are two large artificial clay borrow pits (both about one metre deep) which have historically been used as water collection and treatment settling ponds as part of the stormwater management system for the Hydro Aluminium aluminium smelter site. These ponds are collectively known as the 'North Dam'. Following closure of the Aluminium Smelter, the eastern most pond of the North Dam currently still receives site runoff which Hydro Aluminium is licenced (under their EPL) to discharge to an irrigation area that is located to the north of the Proposal Site. Both ponds of the North Dam currently have a combined capacity of approximately 129,500 m^3.

At the time of this assessment, available water quality data for waterways within the study area was limited. Water quality data was requested from Maitland City Council, Cessnock City Council, Department of Planning, Industry and Environment (DPIE), Hunter Water and Local Land Services (LLS). Maitland City Council, Cessnock City Council and DPIE confirmed that they do not monitor the aforementioned waterways. Additionally, no response was received from Hunter Water. Therefore, historic water quality data that was readily available for review was limited to three years of monthly monitoring data collected by Hydro Aluminium between 2015 and 2017.

13.2.2 Existing surface water quality

The existing water quality data has been compared to the ANZG (2018) water quality default guideline values for the protection of aquatic ecosystems for slightly to moderately disturbed lowland rivers (95 per cent species protection). Where there are no guideline values available for toxicants and stressors for the protection of aquatic ecosystems, other guideline values (irrigation water supply and livestock water supply) have been adopted.

Table 13.1 provides results of the water quality analysis. Based on available data, pH and electrical conductivity were within the default guideline values at all six sites. Dissolved oxygen was below the lower default guideline value at all sites. The majority of trace metals and ions had concentrations below detection limits or below default guideline values for either the protection of aquatic ecosystems (95 per cent species protection) or primary industry (livestock drinking water or irrigation and general water use). The exceptions were chloride, aluminium, lead and zinc, which were above the guideline levels at a minimum of one sampling site. In addition, at the time of sampling, nutrients (TN and TP) were above the guidelines at all sampling sites, with TN concentrations up to 6.8 higher, and TP concentrations up to 19.6 times higher than the default guideline value. These waterways therefore could be susceptible to eutrophication. Results outside the recommended guidelines are shown in bold.

Table 13.1: Median water quality data (Source: Hydro Aluminium, 2015 – 2017; Jacobs, 2020)

Parameter	Unit	Default Guideline Value (ANZG, 2018)	Tributary of Black Waterholes Creek		Black Waterholes Creek		Swamp Creek	
			Site 1(1)	SW1(2)	Site 9(1)	SW2(2)	Site 62(1)	SW3(2)
pH		6.5 – 8.5	7.4	6.7	6.7	5.9	7.6	6.7
Turbidity	NTU	6-50	-	18.0	-	38.6	-	**370**
Dissolved Oxygen	% saturation	85-110	-	**76.9**	-	**37.6**	-	**79.4**
Electrical conductivity	µS/cm	125-2200	1600	790	1500	1313	1250	858
Total Nitrogen	mg/L	0.35	-	**1.3**		**2.4**		**2.4**
Total Phosphorus	mg/L	0.025	-	0.2	-	**0.28**	-	**0.49**
Filterable Reactive Phosphorus	mg/L	0.020	-	**0.06**	-	<0.01	-	<0.01
Calcium	mg/L	1000(3)	-	16	-	10	-	19
Fluoride	mg/L	2(4)	**4.2**	1.7	1.9	**2.1**	0.85	0.8
Chloride	mg/L	350(4)		191		**422**		148
Aluminium	mg/L	0.055		0.001		**0.34**		**0.27**
Arsenic	mg/L	0.024	-	<0.0001	-	<0.0001	-	<0.0001
Boron	mg/L	0.37	-	<0.05	-	<0.05	-	<0.05
Cadmium	mg/L	0.00006	-	<0.001	-	<0.001	-	<0.001
Chromium	mg/L	0.001	-	<0.001	-	<0.001	-	<0.001
Copper	mg/L	0.0014	-	<0.001	-	<0.001	-	<0.001
Lead	mg/L	0.0034	-	**0.004**	-	<0.001	-	<0.001

Parameter	Unit	Default Guideline Value (ANZG, 2018)	Tributary of Black Waterholes Creek		Black Waterholes Creek		Swamp Creek	
			Site 1(1)	SW1(2)	Site 9(1)	SW2(2)	Site 62(1)	SW3(2)
Mercury	mg/L	0.00006	-	<0.0001	-	<0.0001	-	<0.0001
Nickel	mg/L	0.011	-	0.008	-	0.009	-	0.009
Zinc	mg/L	0.008	-	<0.005	-	**0.01**	-	<0.005
Free cyanide	mg/L	0.007	-	<0.004	-	<0.004	<0.005	<0.004

Notes:

1. Sample sites from the Hydro Aluminium surface water monitoring program (2015 – 2017).
2. Project-specific grab sample sites collected by Jacobs in November 2020.
3. DGVs for primary industry (livestock drinking water) (ANZECC/ARMCANZ, 2000).
4. DGVs for recreational water quality (NMHRC, 2008).

13.2.3 Aquatic biodiversity

Freshwater fish habitats in the Hunter region include swamps, floodplains, wetlands, streams and rivers which support a diverse array of native and exotic aquatic species (DPI, 2006). There was, however, no species data available for review for waterways within the study area except for records documented on the Bionet Atlas database (EESG, 2020). The Bionet Atlas only recorded presence of the longfin eel (*Anguilla reinhardtii*) and several exotic species including the Common Carp (*Cyprinus carpio*), Mosquito Fish (*Gambusia holbrooki*), and Gambusia (*Gambusia* sp.) within waterways in a 10 km radius of the study area (EESG, 2020).

The Southern Purple Spotted Gudgeon, which is listed as endangered under the *Fisheries Management Act 1994*, is a benthic species found in northern NSW freshwater rivers, creeks and billabongs with slow-moving or still waters, or in streams with low turbidity. Swamp Creek and Black Waterholes Creek are mapped as predicted habitat for this species (DPI, 2016), however the aquatic environment within the study area is disturbed and degraded. There are no records of the species in the study area to date (EESG, 2020; ALA, 2020), and it is suggested that the species is likely to only inhabit coastal catchments north of Clarence River (DPI, 2017). As such, it is considered highly unlikely that the species inhabits the area therefore a 'seven-part test' of significance for the species has not been undertaken.

Other aquatic species which were observed during the site visit included several species of dragonfly. While no dragonflies were caught for close evaluation, individuals that were observed at the assessment sites resembled the Common Bluetail (*Ischnura heterosticta*), Australian Duskhawker (*Austrogynacantha heterogena*) and Eastern Pygmyfly (*Nannophya dalei*).

13.2.4 Aquatic habitat

The aquatic habitat condition at field assessment sites was assessed against criteria outlined in the NSW Policy and Guidelines for Fish Habitat Conservation and Management (DPI, 2013) and Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull & Witheridge, 2003). Aquatic habitat features and habitat condition at field assessment sites are described in Table 13.2.

Table 13.2: Site descriptions – Aquatic habitat assessment

<table>
<tr><th>Site</th><th>Photo</th><th>Site description</th></tr>
<tr><td>SW1 – Unnamed tributary of Black Waterholes Creek</td><td>
Assessment site SW1 facing upstream

Assessment site SW1 facing downstream</td><td>The unnamed tributary of Black Waterholes Creek is an ephemeral, second order stream (Strahler, 1952) which had low water level and no flow at the time of inspection. The water was mostly clear, had a slight hydrogen sulphide odour and there was an oily sheen, some scum and floating green algae present on the surface of the water. Some nuisance aquatic weed species including Hydrocotyle (Water pennyworts) were also growing on the surface of the water.
The site was located immediately upstream of a large box culvert and west of the recently demolished Hydro Aluminium aluminium smelter site. The eastern bank was mostly cleared containing invasive species including Briza maxima. The western bank is mapped as a Kurri Sand Swamp Woodland community, being densely vegetated with species such as Melaleuca linariifolia and Accacia longifolia. Cotula coronopifolia (Brass buttons), an invasive marsh flower, was present along both embankments.
Physical instream aquatic habitat features at the site consisted of macrophyte beds including Phragmites australis (Common Reed), Typha orientalis (Bulrush), Typha domingensis (Southern cattail) and Schoenoplectus validus (Softstem bulrush). Other observations at the site included presence of several dragonfly species hovering above the waterway.
Threatened fish are not predicted to occur (DPI, 2016), however due to proximity and connection with Black Waterholes Creek and Swamp Creek, there is potential for Purple Spotted Gudgeon (Mogurnda adspersa) to be found in the creek, although this is highly unlikely.
This waterway is not mapped as key fish habitat (DPI, 2007) and does not meet the minimum criteria of KFH, therefore has been classified as ‘Not KFH’ (DPI, 2013). With respect to fish passage, it is classified ‘Class 3 – Minimal fish habitat’ (Fairfull and Witheridge, 2003) due to the presence of the existing culvert downstream.
This unnamed tributary of Black Waterholes Creek has not been identified as a sensitive receiving environment.</td></tr>
</table>

Site	Photo	Site description
Site 2 – Black Waterholes Creek	 Assessment site SW2 facing upstream  Assessment site SW2 facing downstream	Black Waterholes Creek is a perennial, third order stream (Strahler, 1952). At the time of sampling, the water appeared highly turbid, had a strong hydrogen sulphide odour and there was an oily sheen present on the surface of the water. The site was located immediately upstream of a small culvert structure (0.5 m diameter) which flowed out to the swampy area of Black Waterholes Creek. The riparian zone was heavily vegetated with open forest dominated by *Casuarina glauca* (Swamp oak), *Eucalyptus amplifolia* (Cabbage Gum) and *Melaleuca linariifolia* (Flax-leaved Paperbark). Physical aquatic habitat features at this site consisted of riparian vegetation, dense instream 7macrophyte beds including *Phragmites australis* (Common Reed), *Typha orientalis* (Bulrush) and *Cycnogeton procerum* (Water Ribbons) and a large fallen tree submerged instream. Other observations at the site included presence of several dragonfly species hovering above the waterway and native frog species Striped Marsh frog (*Limnodynastes Peronii*). There was also a large infestation of *Salvinia molesta* (Giant salvinia) downstream of the culvert structure. The threatened Purple Spotted Gudgeon (*Mogurnda adspersa*) has been mapped as having potential to occur in this waterway, although due to the presence of the culvert downstream and poor condition of the waterway, it is highly unlikely at this location. This waterway is mapped as key fish habitat (DPI, 2007), and has been classified as 'Type 2 – moderately sensitive key fish habitat' (DPI, 2013) as it is a contains some aquatic habitat features and permanent water, however is largely disconnected to downstream due to the culvert therefore is not expected to be utilised by native species. With respect to fish passage, it is classified 'Class 3 – Minimal fish habitat' (Fairfull and Witheridge, 2003) due to the presence of the existing culvert downstream. Black Waterholes Creek has been identified as a sensitive receiving environment.

Site	Photo	Site description
Site 3 – Swamp Creek	 Assessment site SW3 facing upstream  Assessment site SW3 facing downstream	Swamp Creek is a perennial, fifth order stream (Strahler, 1952). During the time of sampling, the water appeared highly turbid, had a slight hydrogen sulphide odour and there was an oily film and some frothing present on the surface of the water near the bank. Additionally, several gross pollutants were observed within the waterway including floating cattle faeces. The site was located on the southern bank of Swamp Creek, about 500 m downstream of the confluence of Black Waterholes Creek and within a low-lying swampy area that is surrounded by cleared paddock. The riparian zone was largely cleared of vegetation, apart from a dense layer of *Cynodon dactylon* (Couch grass). Physical aquatic habitat features at the site consisted of some scattered instream macrophyte beds including *Phragmites australis* (Common Reed), and two large, flat island formations in the centre of the waterway. Other observations at the site included presence of several aquatic weed species including *Myriophyllum aquaticum* (Parrot feather) and *Salvinia molesta* (Giant salvinia). Several fauna species were also present at the site, such as dragonflies, swans, ducks, as well as cows on the banks and in the waterway. The threatened Purple Spotted Gudgeon (*Mogurnda adspersa*) has been mapped as having potential to occur in this waterway, however due to poor water quality and the condition of the waterway, presence of the species is considered highly unlikely at this location. Despite its condition, the waterway is mapped as key fish habitat (DPI, 2007), and has been classified as 'Type 2 – moderately sensitive key fish habitat' (DPI, 2013) due to being a significant waterway and wetland habitat. With respect to fish passage, it is classified 'Class 2 – Moderate fish habitat' (Fairfull and Witheridge, 2003) due to having permanent water and its connection to important aquatic habitats downstream. Swamp Creek has been identified as a sensitive receiving environment.

13.3 Impact assessment

13.3.1 Construction

Construction of the Proposal presents a risk to degradation of downstream surface water quality if management measures are not implemented, monitored and maintained throughout the construction phase. No direct impacts to aquatic organisms or their habitat is predicted as there would be no instream works required, and only minor works on the river bank associated with the stormwater basin discharge structure. Potential impacts during construction are therefore limited to mobilisation of sediment and contaminants to downstream receiving environments by wind or stormwater runoff and subsequent indirect impacts on aquatic ecosystems. During construction, the following potential impacts were identified:

- Erosion of soils and sedimentation of waterways
- Reduced water quality from elevated turbidity, increased nutrients and other contaminants associated with construction (ie. heavy metals which are bound to sediment or fuels, oils and grease from accidental spills)
- Smothering of aquatic organisms from increased sediments and associated low dissolved oxygen levels
- Potential increased occurrence of algal blooms associated with reduced water quality
- Migration of litter off-site
- Contamination due to accidental leaks or spills of chemicals and fuels.

Erosion and sedimentation

There are a number of construction activities that have the potential to result in soil erosion and subsequent sedimentation of downstream environments if stormwater runoff or wind mobilises exposed soils, including:

- Vegetation clearance at the locations of the proposed new switchyard, the stormwater basin and within the Asset Protection Zone – approximately 2.1 ha of vegetation (including 1.54 ha of native vegetation) would be cleared as part of the Proposal. Vegetation removal would expose soils to weathering processes, increasing the risk of erosion and sedimentation.
- Earthworks, including stripping topsoil and excavation – construction of the Proposal would require general earthworks to prepare the Proposal Site and construction areas, construction of and upgrading access roads, and installation of environmental controls (i.e. construction of the stormwater basin and discharge outlet). Soils exposed during earthworks have the potential to be mobilised to downstream environments via wind and stormwater runoff. Construction of the discharge outlet from the basin would require excavation of the stream bank that may result in short term localised erosion should a large flow event occur before the works were completed. Further, while considered unlikely, the existing fill or natural material that could be disturbed as a result of excavation activities may contain contaminants or acid sulphate soils.
- Movement and use of heavy vehicles – construction of the Proposal will require movement and use of heavy machinery, plant and equipment for the installation of civil, mechanical and electrical components of the Proposal. This could result in generation of dust and increase ground disturbance resulting in increased risk of erosion and sedimentation.

The impacts of erosion and sedimentation on water quality and aquatic environments may include:

- Increased turbidity and poor water clarity, which can potentially lead to smothering aquatic ecosystems due to clogging fish gills or decreasing trophic interactions due to reduced visibility.
- Sediments may also contain high concentrations of nutrients which can lead to algal blooms, and subsequently result in reduced light penetration that limits the growth of aquatic vegetation. Algal blooms may also cause a reduction of dissolved oxygen content in water which can lead to the creation of 'dead zones' where aquatic life cannot survive.
- Mobilised sediments may contain elevated concentrations of metals and other contaminants which can negatively impact aquatic organisms that may be sensitive to changes in water quality.

- Any potential acid sulphate soils that may be encountered in the Proposal Site could also result in increased acidity of downstream receiving environments and may impact on aquatic life that cannot tolerate changes in pH.

While sediment-laden runoff and pollutants from soil disturbance have the potential to temporarily reduce downstream water quality, they are unlikely to cause major or long-term impacts to the overall condition of surrounding waterways as they would be managed with the implementation of erosion and sediment controls. Erosion and sediment controls and other management measures would be established prior to commencement of construction activities (including vegetation clearing) to avoid and/or manage erosion and sedimentation impacts from construction activities. In addition, the discharge outlet will be designed and constructed so that the structural integrity of the unnamed tributary of Black Waterholes Creek riverbank is retained, and bank failure or bank erosion is avoided. Given the limited areas of deeper excavation and limited if any dewatering anticipated, low pH runoff associated with ASS is unlikely. In the event that any acid sulphate soils are disturbed during excavation, an acid sulphate management strategy would be prepared and implemented as part of the Construction Environmental Management Plan (CEMP) in accordance with the Acid Sulphate Soil Manual (ASSMAC, 1998).

Vegetation clearing

In addition to increased risk of erosion and sedimentation from exposure of topsoil, vegetation clearing may result in the release of tannin leachate that could mobilise to downstream receiving waterways via stormwater runoff, ultimately leading to fish kills. However, the risk of tannin leachate mobilising to downstream receivers is considered low as vegetation clearing required for the Proposal is minimal and erosion and sediment controls, as well as additional management measures, would be established on-site prior to any vegetation clearance works being carried out.

Concreting

The risk of concreting works can result in pollution to waterways, having the potential to alter the pH of downstream watercourses which can be harmful to aquatic life that are sensitive to changes in water quality. The risk of transportation of concrete waste is considered low as concreting will not occur within proximity of waterways and water quality controls and management measures would be implemented to ensure no runoff is mobilised downstream prior to being captured and treated in temporary construction sediment basins.

Accidental spills and litter

The release of litter and potentially harmful substances to the environment may occur accidentally during construction due to workers not placing rubbish in allocated areas and spills or leaks as a consequence of equipment malfunction, maintenance or refuelling. Spills may cause oily films to be transported to downstream receiving waters via stormwater runoff which may accumulate on the surface water and reduce visual amenity or result in loss of habitat and aquatic organisms from increased concentrations of toxicant and altered pH levels. Mobilisation of litter to waterways may lead to the introduction of gross pollutants (rubbish), nutrients, hydrocarbons and heavy metals into waterways which may be harmful to aquatic life and reduce visual amenity.

While there is potential for accidental spills from construction machinery and littering on construction sites, it is unlikely to result in any major or long-term impact to downstream water quality and aquatic ecosystems as impacts would be temporary and manageable through site specific controls, which would be further developed and implemented as part of the CEMP.

Surface water discharges

Water discharges during construction of the Proposal are associated with dewatering the construction sediment basin which would be managed in accordance with Blue Book. The requirements of the Blue Book are that local erosion and sediment controls be provided within the construction catchment area and adequately sized construction sediment basin at the discharge points of all outlets from construction sites. As per the Blue Book, the pollutants of concern during the construction process are total suspended solids (TSS), pH and oil and grease. The treatment criteria of these pollutants would be in accordance with the Blue Book or any applicable EPL. Often nutrients and metals are bound to sediments and transported from the construction site. The capture of the sediments via the construction sediment basin would subsequently result in the capture of nutrients and toxicants thereby reducing risks to downstream water quality.

With the implementation of controlled dewatering from the construction sediment basin in accordance with the Blue Book risks to water quality is expected to be low and unlikely to cause a major or long-term impact to downstream receiving environments.

13.3.2 Operation

Following construction, the potential for impacts to water quality would be limited as there would be no on-going ground disturbance and all exposed surfaces would be sealed or landscaped as required. There would be no exposed topsoil and therefore little to no risk of soil erosion and subsequent transport of sediment to downstream receiving waterways. Further, the Proposal will include a stormwater drainage system that will be designed to minimise release of contaminants (generally oil and sediments). Stormwater quality modelling predicted that the stormwater basin (which will also act as a water quality basin) will reduce pollutant loads flowing to the receiving downstream waterway (unnamed tributary to Black Waterholes Creek) compared to the current situation. It is possible that other water sensitive urban design alternatives that achieve similar levels of pollutant load reductions to the water quality basin may be adopted during detailed design.

The Proposal is not expected to impact on achieving the environmental values of protection of aquatic ecosystems or visual amenity, nor impacts on the environmental values of primary or secondary contact recreation, irrigation water supply and homestead water supply. The potential impacts for uncontrolled release of process water or contaminated stormwater, potential spills or leaks and overflows will be managed by the design and Operational Environmental Management Plan.

Stormwater runoff

The eWater Model for Urban Stormwater Improvement Conceptualisation (MUSIC model) was applied to derive pollutant loads from the Proposal Site, specifically TSS, TN and TP, to determine the approximate size of the permanent water quality basin, and that runoff from the Proposal Site complies with the water quality objectives outlined herein. The MUSIC model predicted there to be a reduction in pollutant loads flowing to the receiving downstream waterway, therefore there is potential for the Proposal to improve water quality in the tributary to Black Waterholes Creek.

Accidental spills or leaks

General operation of the Proposal may result in spills or leaks as a consequence of plant or equipment malfunction, maintenance or refuelling. Accidental spills may occur as a result of inappropriate storage, handling and use of plant and equipment (including vehicles on-site).

While there is potential for spills and leaks, the design of the Proposal includes capture and treatment of stormwater from any process areas where contamination could be expected. Additionally, all stormwater passes through the stormwater basin (which will also act as a water quality basin) with before being discharged from the Proposal Site. Additional management measures to be implemented during operation would further ensure impacts to water quality are avoided or adequately managed.

13.4 Mitigation measures

With regard to surface water quality and aquatic ecology, the key objective is to ensure downstream waterways are protected against potential impacts from construction and operation of the Proposal. Measures to avoid, minimise or manage surface water and aquatic ecosystem impacts as a result of the Proposal are detailed in Table 13.3.

Furthermore, the environmental management measures should include a surface water quality monitoring program which would include the collection of baseline data for comparison to construction and operational monitoring data where applicable.

Table 13.3: Recommended environmental management and mitigation measures

Reference	Environmental Management Measure	Timing
SW01	A construction erosion and stormwater management plan will be prepared as a sub-plan of the CEMP in accordance with the principles and requirements of *Managing Urban Stormwater – Soils and Construction, Volume 1* (Landcom, 2004), commonly referred to as the “Blue Book”. It will outline measures to manage soil and water impacts including measures to minimise/manage erosion and sediment transport, dust control, design and maintenance of sediment basin/s, dewatering of construction sediment basins and discharge criteria, and management of accidental spills.	Construction
SW02	A construction surface water monitoring program will be developed and implemented during construction in accordance with the ANZG (2018) water quality guidelines.	Construction
SW03	Site specific controls and procedures will be developed and implemented as part of the Operational Environment Management Plan (OEMP) to mimimise the risk to surface and groundwater from stormwater and potentially harmful chemicals. The OEMP will include an emergency spill response procedure, and an uncontrolled water discharge response, monitoring of discharges of oily water separator pit and visual assessment of downstream waterway condition.	Operation

14. Hydrology and flooding

A Hydrology and Flooding Impact Assessment is provided in Appendix J and summarised in the following sections.

14.1 Assessment methodology

The hydrology and flooding assessment included the following:

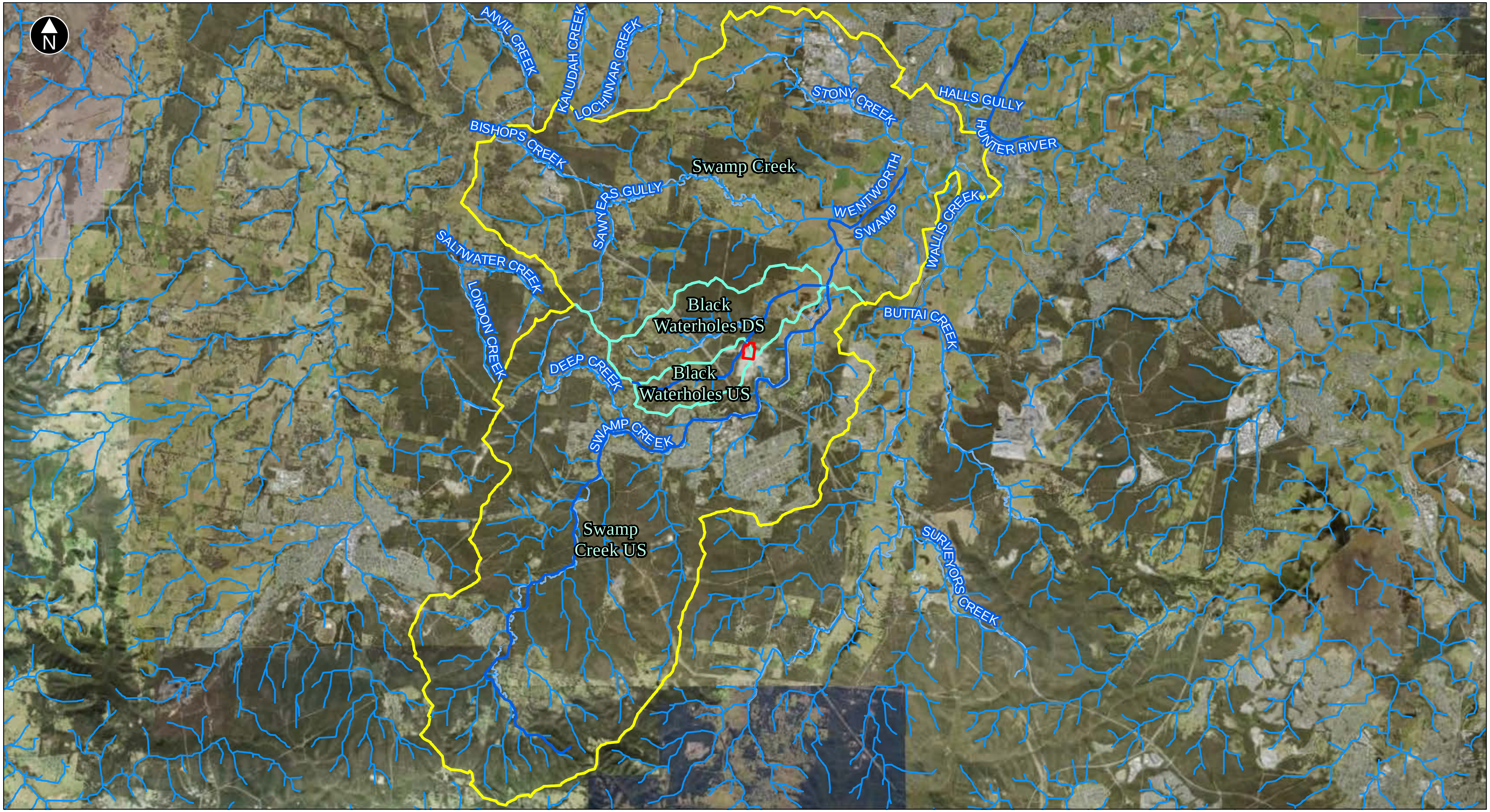
- Desktop review of publicly available flood study reports from local council(s) and other sources to characterise existing flooding conditions at the Proposal Site and the surrounding areas. Sources included:
  - Hunter River: Branxton to Green Rocks Flood Study (WMAwater, 2010)
  - Wallis and Swamp Fishery Creek Flood Study (WMAwater, 2019)
  - Cessnock City Council online flood mapping
  - Environmental Impact Statement – Former Hydro Aluminium Kurri Kurri Smelter Demolition and Remediation (Ramboll Environ, 2016)
  - Hydro Aluminium Kurri Kurri Stormwater Management Report - Flood Modelling and Hydrology Review (PCB, 2018)
  - LiDAR ground level data.
- Qualitative assessment of potential impacts to flooding as a result of construction and operation of the Proposal. Given the very low flood risk of the Proposal Site, quantitative modelling assessment of flooding impacts was not warranted and consequently not undertaken
- Identification of the potential impacts from flooding on the Proposal
- Assessment of potential impacts to surface water hydrology as a result of construction and operation of the Proposal. Potential changes to stormwater discharges from the Proposal Site were estimated using DRAINS hydrological modelling software (version 2020.042). A quantitative analysis of stream flow regimes was not conducted as the watercourses relevant to the Proposal are ungauged and no stream gauge data is available for any representative watercourses within an acceptable distance
- Identification of appropriate mitigation and management measures.

14.2 Existing environment

14.2.1 Regional setting

The Proposal Site is situated within the Wallis Creek catchment, a tributary of the Hunter River. Named tributaries of Wallis Creek include Swamp Creek, Deep Creek, Sawyers Creek, Black Waterholes Creek and Bishops Creek (Figure 14.1). Local receiving waterways for the Proposal Site comprise of Swamp Creek to the east and an unnamed tributary of Black Waterholes Creek which flows along the Proposal Site's western boundary. Black Waterholes Creek and Swamp Creek converge approximately 2.25 km north-east of the Proposal Site into Wentworth Swamp. Downstream of Wentworth Swamp, Swamp Creek subsequently discharges into Wallis Creek approximately 1.5 km south of South Maitland. While all watercourses and drainage lines within the Wallis Creek catchment are ephemeral, the lower reaches of Wallis Creek are located on the extensive Hunter River floodplain and are subject to tidal influence from the Hunter River (WMAwater, 2019).

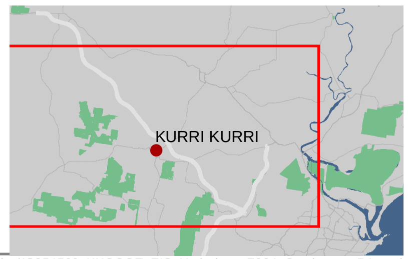
Table 14.1 summarises relevant attributes of watercourses relevant to the Proposal Site.



Proposal site
Catchment
Subcatchment
Main stream
Watercourse

0 2 4 km

1:150,000 at A4
Coordinate System: GDA2020 MGA Zone 56



Data sources:
Jacobs 2020
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 14-1 Surface Water Features and Catchments

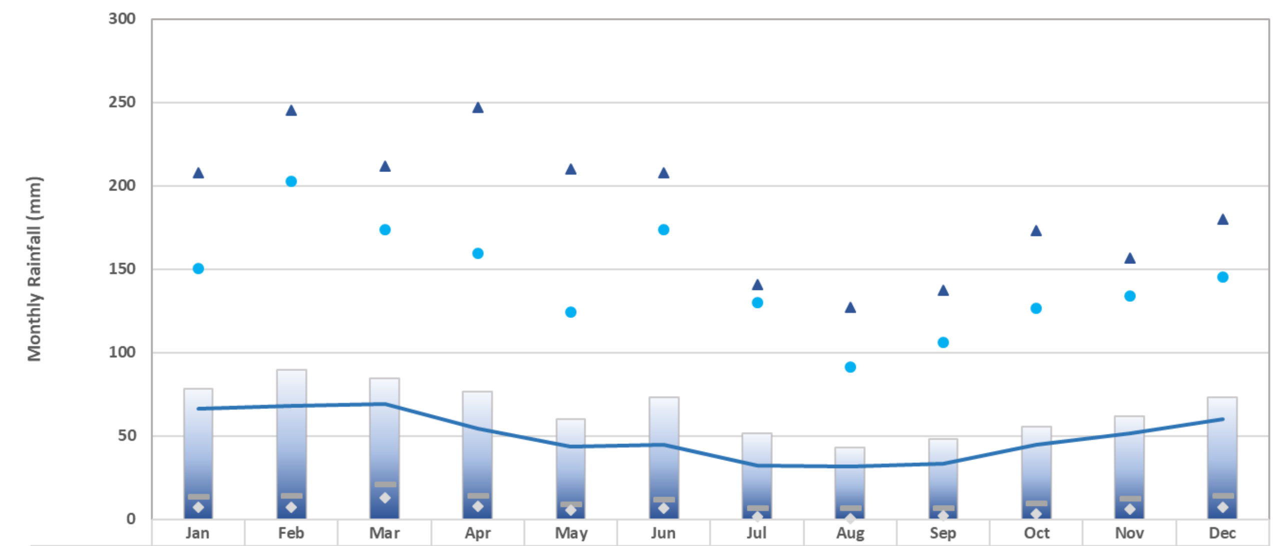
Table 14.1: Watercourse Summary

Watercourse	Description	Details in relation to the Proposal
Swamp Creek	Major tributary of Wallis Creek which subsequently discharges into the Hunter River east of Maitland. Total catchment area of approximately 23,300 ha of which approximately 1,700 ha is comprised of Black Waterholes Creek catchment. Total catchment upstream of tributary with Black Waterholes Creek is approximately 11,600 ha.	Flows along the eastern boundary of the Proposal Site. Adjacent to the Proposal Site, the main channel of Swamp Creek flows in a northerly direction and is comprised of a moderately sinuous (i.e. degree of meanders and bends), well-defined channel traversing an extensively cleared catchment. Riparian vegetation is largely present although at times discontinuous. Downstream of the Proposal Site, the main channel appears increasingly sinuous as it enters an extensively cleared floodplain and discharges into Wentworth Swamp.
Black Waterholes Creek	Total catchment area of approximately 1,700 ha of which approximately 443 ha is upstream of the Proposal Site. The main channel typically flows in an easterly direction before discharging into Wentworth Swamp at the confluence with Swamp Creek.	Black Waterholes Creek rises approximately 4 km to the west of the Proposal Site. It is a tributary of Swamp Creek, which it joins approximately 2.25 km north-east of the Proposal Site. An unnamed tributary flows northwards adjacent to the western boundary of the Proposal Site.

14.2.2 Climate

The climate at the Proposal Site has a Köppen classification (used to describe climate classification systems) of temperate (no dry season (hot summer)) with mean maximum summer temperatures of 29.2°C to 30.5°C and mean maximum winter temperatures of 17.6°C to 19.5°C (Cessnock Airport AWS 061260).

Representative long term rainfall data for the Proposal Site was obtained from the Bureau of Meteorology's (BoM) network of weather recording stations and is presented in Figure 14.2.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	78.3	89.7	84.5	76.3	60.1	73.2	51.6	42.9	48.3	55.1	61.9	73.2
95th %ile	207.7	245.0	211.6	246.7	210.1	207.9	140.7	126.8	137.1	173.0	156.5	180.0
90th %ile	150.6	202.6	173.6	159.3	124.1	173.4	129.9	91.3	105.8	126.4	133.7	145.1
Median	66.0	67.8	69.3	54.2	43.6	44.4	32.1	31.7	33.0	44.5	51.4	59.9
10th %ile	13.4	14.1	21.0	13.8	8.7	11.7	6.3	6.4	6.7	9.2	12.4	14.2
5th %ile	7.3	7.1	12.8	7.9	5.4	6.6	1.4	0.4	1.7	3.4	6.0	7.0

Source: BoMl, 1900-2020

Figure 14.2: Monthly Rainfall Statistics

14.2.3 Watercourse hydrology

As discussed in Section 12.1, quantitative analysis of stream flow regimes has not been conducted. However, the following qualitative observations are made:

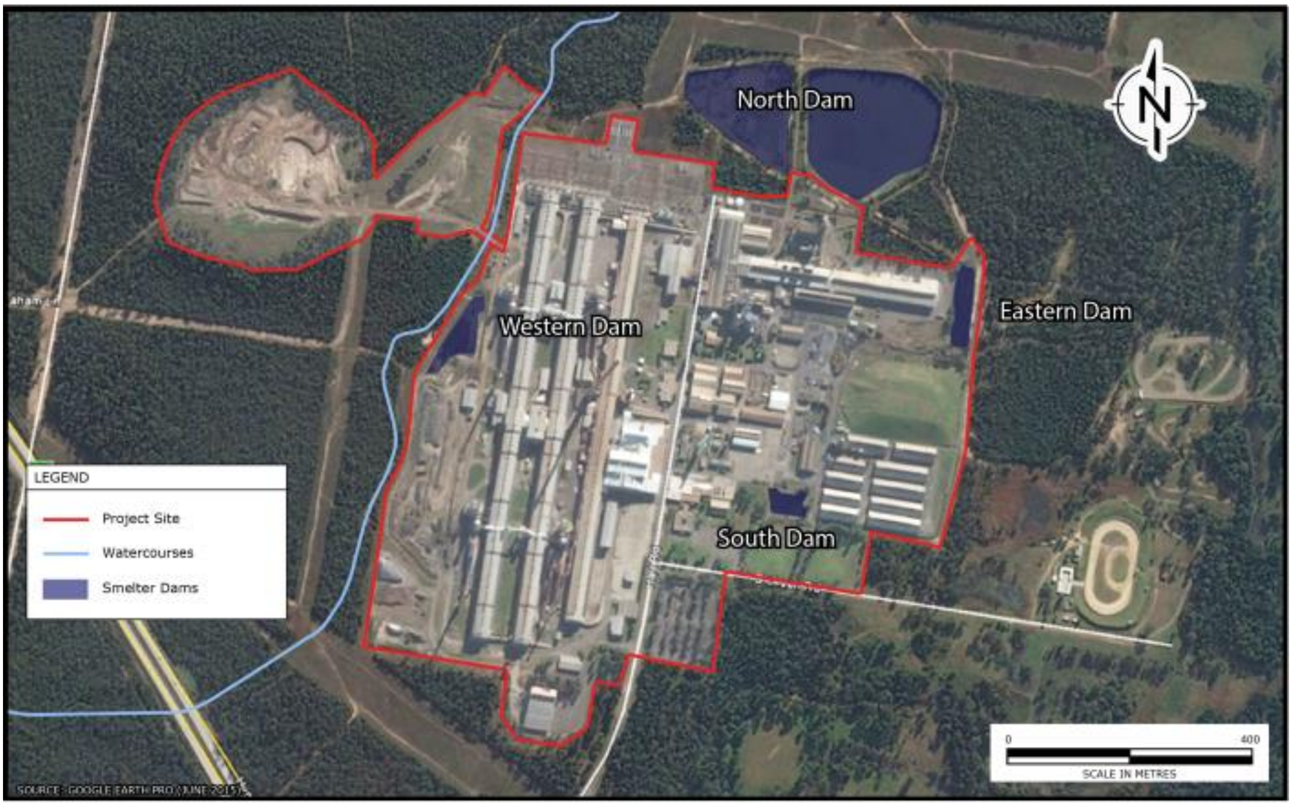
- Watercourses are described as ephemeral (WMAwater, 2019) and, in the instance of the unnamed tributary of Black Waterholes Creek, likely to be largely episodic, subject to flow only during and after rainfall events and followed by relatively rapid recession
- Flows are unlikely to be strongly seasonally distributed although a summer high flow season is expected due to the higher monthly rainfall during the summer
- The low channel gradients and channel geomorphology of the mid to low catchments are likely to result in prolonged storage of standing water within the channel giving rise to a series of ponds and waterholes.

14.2.4 Drainage conditions

The drainage conditions relating to the Proposal Site are described below in Table 14.2.

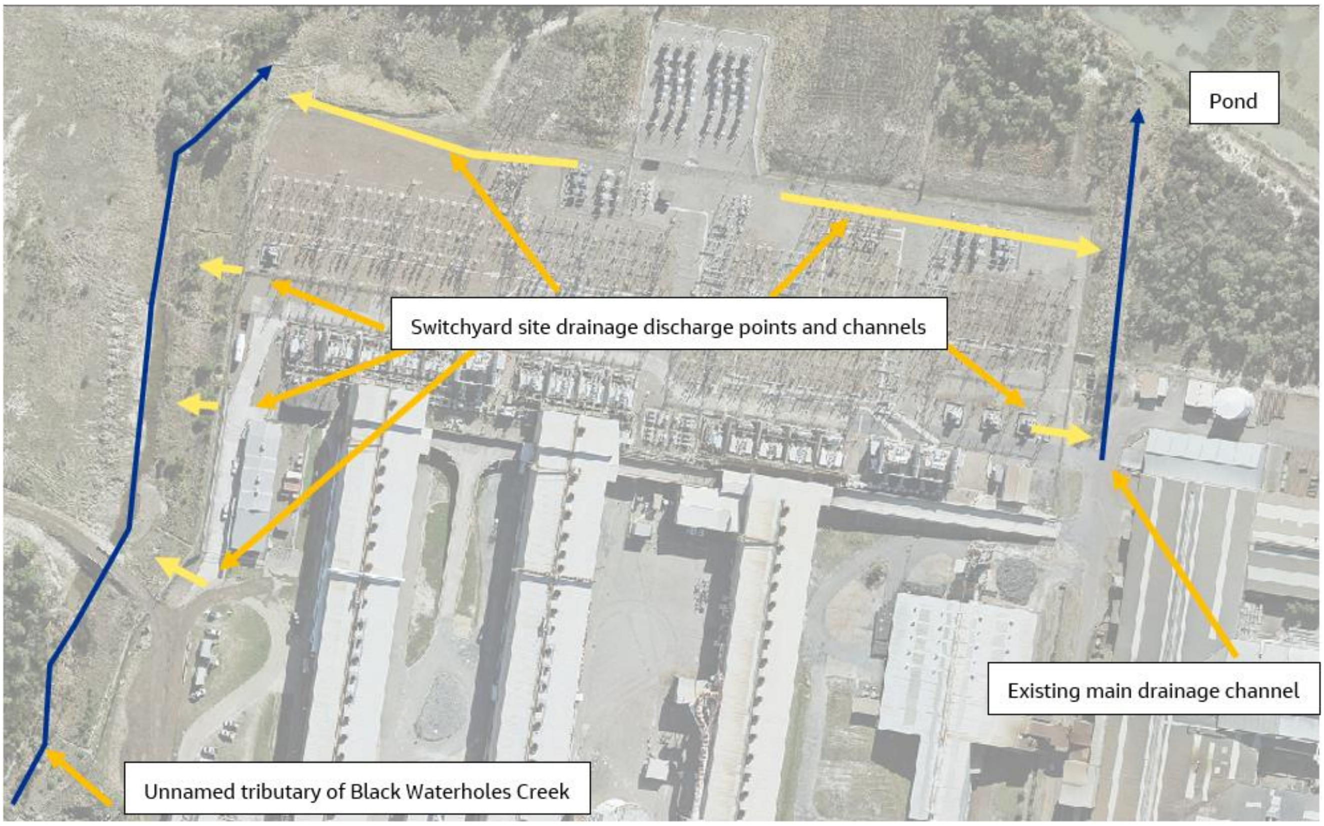
Table 14.2: Historical and existing drainage conditions of the Proposal site

Period	Conditions
Historical site drainage	The Hydro Aluminium Kurri Kurri smelter site was originally constructed on a raised pad constructed to approximately 16 m AHD (Australian Height Datum measured in metres). Grading of the pad was completed to facilitate drainage, and during the operational phase of the smelter flows initially reported to three dams located within the smelter site (South, Eastern and Western Dams) (Figure 14.3). The dams served as the initial collection and treatment points for stormwater (Ramboll Environ, 2016). Two additional large stormwater retention ponds are located in the north-east of the smelter site (known as the North Dam). These were used as part of the water collection and treatment system for the smelter capturing surface water runoff from the site as well as receiving water that had passed through the East and West Dams.
Existing site drainage	The Proposal Site is located at the north-western corner of the former aluminium smelter site. Review of LiDAR ground elevations and aerial photography indicates that the eastern half of the Proposal Site drains to the North Dam, with drainage channels and pipe outlets visible on aerial photography and observed during field visits. The western half of the Proposal Site drains via overland flow, shallow channels and pipes to the unnamed tributary of Black Waterholes Creek (Figure 14.4). However, for the purposes of the hydrology assessment it is assumed that 100 per cent of the Proposal Site gravity drains to the unnamed tributary of Black Waterholes Creek. This is to reflect natural site drainage conditions (without the smelter site retention ponds).



Source: Ramboll Environ (2016)

Figure 14.3: Historical site drainage

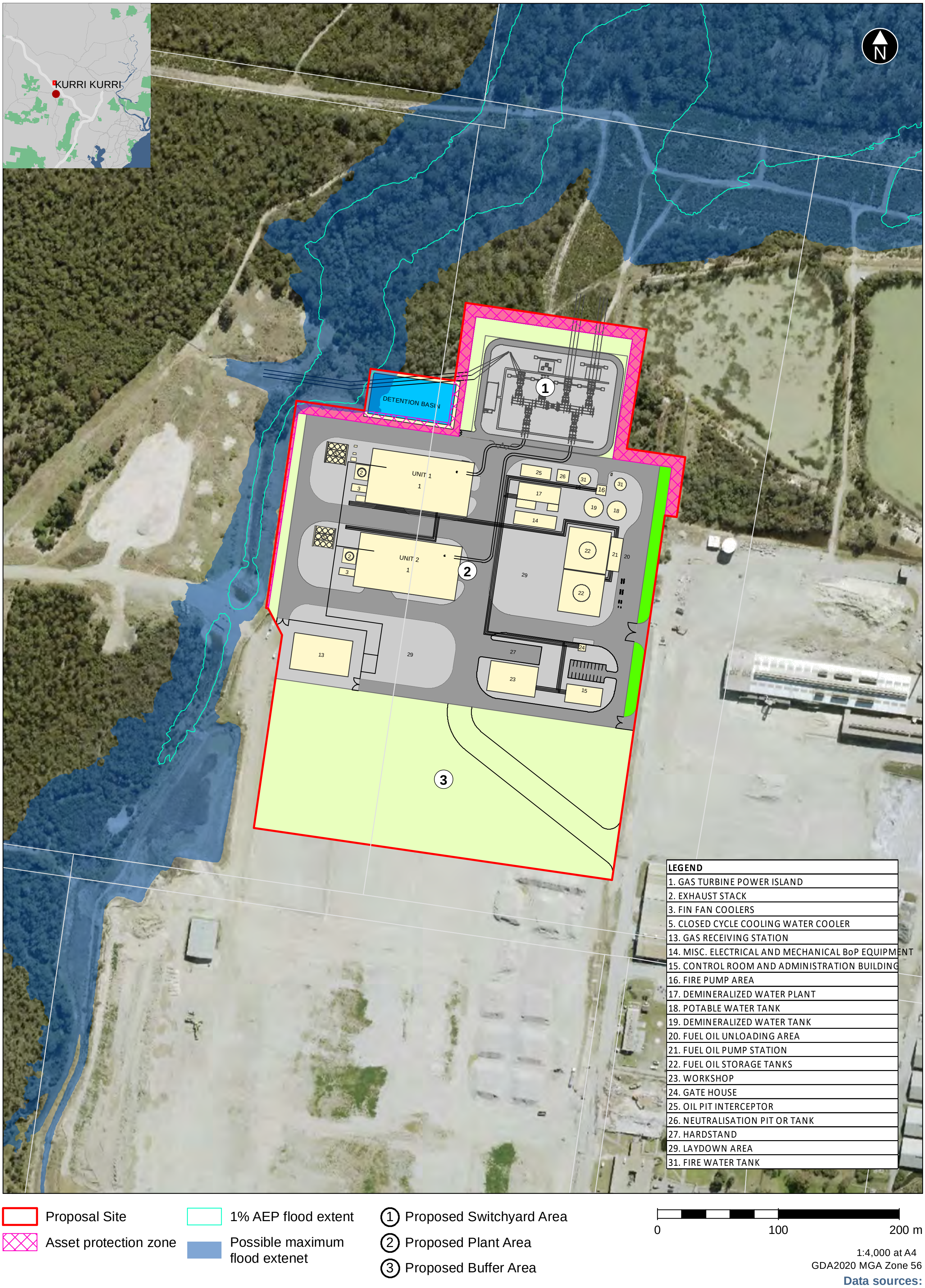


(Aerial photography circa 2018, prior to demolition of the smelter)

Figure 14.4: Existing site drainage arrangements

14.2.5 Existing flood conditions

Flooding at the Proposal Site occurs as a result of both local catchment flooding in the unnamed tributary of Black Waterholes Creek and backwater flooding from the Hunter River. For flood events up to and including the 2 per cent Annual Exceedance Probability (AEP) event, local catchment flooding in the unnamed tributary of Black Waterholes Creek dominate peak flooding at the Proposal Site. Peak flood levels and depths at the Proposal Site in the 1 per cent AEP event and larger are dictated by Hunter River backwater flooding, rather than flooding from local watercourses (WMAwater, 2019). The 1 per cent AEP flood level is 9.73 mAHD and the Probable Maximum Flood (PMF) level is 11.71 mAHD (WMAwater, 2010) for the current climate (no climate change). The flood extents are mapped in Figure 14.5 based on the reported peak flood levels and LiDAR data. The Proposal Site is entirely above the PMF level.



Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 14-5 Regional flood extents

14.3 Impact assessment

14.3.1 Construction

Hydrology

Construction of the Proposal could potentially affect hydrology (frequency, volume, rate, duration and velocity) and increase peak stormwater flows during storm events as a result of the following activities:

- Vegetation clearance and reduced rates of stormwater infiltration associated with further soil compaction and introduction of impervious layers
- Temporary alteration or restriction of existing drainage paths and catchments
- Additional impervious surfaces and formalised drainage
- Discharge of flow from the proposed sediment basin, designed to capture all stormwater from an 85th percentile five day rainfall event.

Site Water Balance – construction

Key water demands during construction of the Proposal would include:

- Earthworks – conditioning of bulk fill materials and pavement foundations
- Dust suppression – access tracks and work areas
- Concrete curing
- Irrigation for revegetation and landscaping
- Potable water for use at site offices, crib rooms and ablutions.

Indicative water demands are summarised in Table 14.3 and are based on preliminary estimates of construction material quantities.

Over the duration of construction (anticipated to be approximately two years), approximately 8.5 ML of water is estimated to be required, nominally 4.25 ML per year. This is equivalent to an average daily demand of approximately 11.6 kL for a 12 hour working day.

Water demands would be supplied by Hunter Water via their existing potable water network, with a connection available in the vicinity of the Hart Road and Dickson Road junction. Reuse of water from a proposed sediment basin cannot be guaranteed as there is an environmental requirement to empty the basin within five days after a storm event. However, water from the sediment basin may potentially be used for dust suppression and fill conditioning, depending on availability.

Table 14.3: Estimate of total construction water demands

Water Use	Requirement (ML)	Assumption
Earthworks	0.10	Allowance to increase antecedent soil moisture content by 5% to reach optimum moisture content. ▪ 2,000 m^3 fill requirement
Dust suppression	3.65	Allowance of two 10,000 L tankers per day for summer months for duration of construction (assumed 2 years)
Concrete batching	Nil	▪ Assume procured offsite and imported

Water Use	Requirement (ML)	Assumption
Concrete curing	0.25	▪ Allowance of 5% of concrete volume (20 L per tonne) ▪ 12,000 tonnes of concrete (approx. 5,000m^3) assumed
Irrigation	0.12	▪ Allowance 2,000 L per day for last two months of construction
Potable	4.38	▪ Allowance of 50 L per day per person for duration of construction ▪ Estimated average workforce per day of 120 personnel
Total	**8.5**	

Stormwater discharge locations

Stormwater discharge during construction would occur via one or more sediment basins. Discharge would be monitored and managed in accordance with a Construction Environmental Management Plan (CEMP) and any relevant regulatory conditions.

Any wastewater produced during construction would be collected and disposed of off-site at an approved facility or discharged to Hunter Water's existing sewer system located within the existing aluminium smelter site.

14.3.2 Operation

Hydrology

Development of the Proposal Site could potentially increase peak stormwater flows during storm events due to additional impervious surfaces and formalised drainage. These potential increased peak flows were modelled for the operational phase of the Proposal.

However, the stormwater detention basin (or other measure) will maintain or reduce peak flows discharged to the unnamed tributary of Black Waterholes Creek up to the 1 per cent AEP event. A preliminary calculation of the required detention volume is 2,240 m^3. Further details of the proposed stormwater detention basin, such as surface area, shape and functioning, are outlined in the Hydrology and Flooding Impact Assessment (Appendix J) and would be subject to detailed design.

Where there is limited space, unsuitable topography, contaminated soils or groundwater, other constraints or owner/ operator's preferences, it is possible to adopt other alternatives to the stormwater detention basin that achieve similar outcomes for peak flow attenuation. These alternatives include, for example, measures to increase stormwater infiltration (porous pavements, swales, infiltration pits) and various forms of storage (oversized pits and pipes, various types of tanks, or shallow ponding over portions of a site such as roads, car parking areas, or undeveloped portions of land). The most suitable methods will be resolved during the detailed design process with the selected design and installation contractors.

Stormwater modelling (DRAINS) results

Table 14.4 below summarises the stormwater discharge modelling results, showing peak discharge rates from the Proposal Site for the existing and proposed case. Results are shown for a range of design storm events from 63 per cent AEP (i.e. once per year) to 1 per cent AEP.

There is a reduction in peak discharge rates to the receiving environment (unnamed tributary of Black Waterholes Creek) for all storm events.

Table 14.4: Stormwater Drainage Assessment Results Summary

Event	Existing Case Peak Discharge (m^3/s)	Proposed Case Peak Discharge (m^3/s)	Change in Total Peak Discharge	
			Absolute (m^3/s)	Relative (%)
63% AEP	0.87	0.77	-0.10	-11.7%
50% AEP	1.21	1.05	-0.16	-13.2%
20% AEP	1.72	1.43	-0.29	-16.9%
10% AEP	2.30	2.03	-0.27	-11.7%
5% AEP	2.87	2.52	-0.35	-12.2%
2% AEP	3.73	3.27	-0.46	-12.3%
1% AEP	4.48	4.42	-0.06	-1.3%

NSW river flows objectives

As outlined in the Hydrology and Flooding Impact Assessment (Appendix J), the Proposal is not expected to have a material impact on any of the relevant NSW river flow objectives.

Flooding

The existing and proposed site levels at the Proposal Site are above the Probable Maximum Flood (PMF) level. The Proposal during operation would not result in loss of floodplain storage or flow obstruction. Accordingly, there would be no changes to flood behaviour affecting existing developments, infrastructure or flood emergency evacuation routes.

The PMF is more than 0.5 m higher than the 1 per cent AEP flood level and the Proposal Site is above the PMF. This meets the adopted design criteria and performance outcomes for the Proposal.

Consideration of climate change impacts on flooding

The Proposal is expected to have an operational life of approximately 30 years. Based on the information presented in WMAwater (2010), the 1 per cent AEP flood level is estimated to increase from year 2021 levels by approximately 0.2 m for every 10 per cent increase in rainfall as a result of climate change. The *Australian Rainfall and Runoff 2019* suggests a 9 per cent increase in storm rainfall intensities in the Hunter Region between 2021 and 2050. Hence, the 1 per cent AEP Hunter River flood level could increase by 0.2 m by the year 2050. This level remains below the current low point of the Proposal Site.

Based on current climate change guidance relating to storm rainfall intensity and flooding, the PMF level is not expected to increase as a result of climate change in this timeframe. Hence, the Proposal is expected to remain above the PMF level during its design life under climate change conditions.

Site water balance

Key water demands during the operation of the Proposal include:

- Input to the demineralised water treatment plant for the production of demineralised water for wet compression/fogging and NOx emission control when operating on diesel
- Inlet air / evaporative cooling for the gas turbines
- Supply to workshops, amenities and administration buildings, including kitchens, safety showers, eyewash facilities, etc.
- Make-up supply for the firefighting and emergency facilities
- Plant wash down.

The operational water demands will vary depending on the type of fuel used, with natural gas having a significantly lower water consumption than when needing to operate on diesel fuel. Significant variation in annual water usage is also dependent on ambient temperature and the utilisation rate of evaporative coolers and wet compression fogging.

Indicative water demands based on the largest expected F Class gas turbine are summarised in Table 14.5 and Table 14.6. Water tanks on site will buffer instantaneous water demand. Water demand will be dependent on the eventual gas turbine selected for the Proposal and would be refined during the detailed design process.

The estimated potable water demand, emanating from the potable water tank, for the Proposal is expected to be up to approximately 133 kL/hr. This does not correspond to the instantaneous water demand on the Hunter Water supply connection due to the presence of the potable and demineralised water tanks on site which help buffer out the instantaneous demands.

Nitrous oxide (NO_x) emission control inflates the demand for demineralised water when a dual-fuel turbine is operating on diesel fuel (see Section 2.2.4). Demineralised water would be produced on site via a demineralisation water plant which would be fed from the potable water supply.

The indicative total annual water demand for operation of the Proposal is approximately 80 ML based on a 10 per cent capacity factor on gas and 2 per cent capacity factor on diesel (total of 1,051 hours per year, comprising approximately 876 hours on gas and 175 hours on diesel fuel).

All operational water demands can be supplied to the Proposal by Hunter Water via a new connection to their existing potable water network.

Table 14.5: Estimated water demand for main components when operating on natural gas

Component	Units	Water Demand for 2 x Units
Potable water: Total	**kL/h**	**133.1**
Evaporative cooler make-up	kL/h	67.7
Demineralised Plant Supply	kL/h	65.3
Domestic Use	kL/h	0.075
Demineralised water: Total	**kL/h**	**64.8**
Wet compression / fogging	kL/h	57.6
NOx emission control	kL/h	0.0
Compressor washing (as required)	kL/h	7.2

Table 14.6: Estimated water demand for main components when operating on diesel fuel

Component	Units	Water Demand for 2 x Units
Potable water: Total	kL/h	133.1
Evaporative cooler make-up	kL/h	67.7
Demineralised Plant Supply	kL/h	65.3
Domestic Use	kL/h	0.075
Demineralised water: Total	kL/h	151.2
Wet compression / fogging	kL/h	0.0
NOx emission control	kL/h	144.0
Compressor washing (as required)	kL/h	7.2

Project discharge locations

Stormwater discharge from the Proposal would occur via a proposed stormwater detention basin (subject to detailed design). Discharge would be monitored and managed in accordance with an Operational Environmental Management Plan (OEMP) and any relevant regulatory conditions.

Process wastewater and sewage would be collected and disposed of to an existing Hunter Water sewer under a trade waste agreement.

The indicative total annual wastewater volume for operation of the Proposal is approximately 16.2 ML, again based on a 10 per cent capacity factor on gas and 2 per cent capacity factor on diesel. As mentioned previously, the expected capacity factor is only 2 per cent per year which would result in considerably less water demand and wastewater disposal volumes.

14.4 Mitigation measures

A suite of management and mitigation measures have already been incorporated into the Proposal. Potential impacts during construction and operation of the Proposal will be mitigated through implementation of measures outlined in Table 14.7.

Table 14.7: Hydrology and flooding mitigation measures

Reference	Mitigation measure	Timing
HF1	The construction erosion and stormwater management plan will incorporate procedures and schedule for monitoring of the receiving waterway (tributary of Black Waterholes Creek) downstream of the discharge location(s) to identify any evidence of channel erosion and scour.	Construction and operation

15. Air quality and greenhouse gases

This chapter presents a summary of the Air Quality and Greenhouse Gas assessment of the Proposal. Sections 15.1 to 15.3 address issues relating to air quality, while Section 15.4 summarises the greenhouse gas assessment, including the assessment methodology and impacts during construction and operation.

This assessment was prepared to address the SEARs relating to air quality, detailing potential air quality impacts due to future operation of the Proposal and providing an assessment of potential impacts of the Proposal on greenhouse gas emissions. Further details are available in the technical report at Appendix K.

15.1 Air quality assessment methodology

The level of assessment of likely air quality impacts was commensurate with the significance or degree or extent of impact within the context of the proposed location and surrounding environment and having regard to applicable NSW Government policies and guidelines.

15.1.1 Air quality context

The power station will be fuelled by natural gas normally, with diesel used as a backup fuel. This might include up to six months of diesel-only operation during 2023 before the natural gas supply to the Proposal Site is completed. The power output by the power station and air pollutant emissions profile will be different for each fuel type.

Typical air pollutants of concern for natural gas fuelled turbine generators are nitrogen dioxide (NO_2) and some hydrocarbons, known as Volatile Organic Compounds (VOCs). Indirectly, emissions of oxides of nitrogen (NO_x), VOCs, and carbon monoxide (CO), contribute to the photochemical formation of ozone (O_3) in the ambient atmosphere. Emissions of some other air pollutants from gas turbines, such as CO and sulphur dioxide (SO_2) are of less concern in that they are unlikely to lead to high concentrations relative to the corresponding ambient (or background) air quality standards and their criteria.

Typical air pollutants of concern for diesel-fuelled turbine generators are NO_2, some VOCs, and some small airborne particles or 'aerosols', measured in the ambient atmosphere as particulate matter (particles of diameter 10 microns or less, or PM_{10}) and fine particulate matter (particles of diameter 2.5 microns or less, or $PM_{2.5}$). Emissions of SO_2 may also be of concern depending on sulphur content of the fuel, and if background SO_2 levels are already high in the particular area of interest.

15.1.2 Assessment methodology

The potential air quality impacts of the Proposal were determined from results of computer-based dispersion modelling. The assessment was undertaken in accordance with the modelling assessment requirements detailed in EPA (2016), which includes guidelines for the preparation of meteorological data, reporting requirements and the use of air quality assessment criteria to assess the significance of model-predicted air quality impacts. The modelling was based on the use of the Calmet and Calpuff models, with model settings following the guidance of Barclay and Scire (2011).

The methodology for assessment of air quality impacts arising from the Proposal broadly includes:

- Identifying discrete sensitive receiver locations (e.g. residential properties, or other locations potentially impacted by the Proposal) using aerial imagery
- Performing meteorological modelling to determine the direction and rate at which emissions are likely to disperse from a given source
- Performing Calpuff modelling to provide a simulation of the effects of varying (over space and time) meteorological conditions on pollutant transport

- Applying the peak-to-mean ratio to convert hourly-average ground level concentrations (GLC) due to point source emissions to a sub-hourly average GLC; and to convert hourly-average ambient air pollutant concentrations
- Applying the NO_x to NO_2 Conversion: Ozone Limiting Method (OLM), to convert modelled results for dispersed NO_x to NO_2 GLCs, using hourly background NO_2 and O_3 data.

The air emissions data for this assessment were reviewed against the National Pollutant Inventory (NPI) emissions factors (DEWHA, 2008), and corresponding U.S. 'AP-42' data (U.S. EPA, 2004). In terms of the Proposal's air emissions, the gas turbines (GT) operating at a stable operating load, down to a specified minimum value, would meet the air emissions limits listed in Table 15.1. Note some of the Proposal limits are more stringent than NSW Government air emissions limits specified in the *Protection of the Environment Operations (Clean Air) Regulation 2010* (Clean Air Regulation).

Table 15.1: Proposal – Air Emissions Limits

Substance and parameter	**Assumed Proposal Operating Maximum**	**Regulatory Limits[1]**	**Comments**
Oxides of nitrogen (NO_x) 1-hour average, natural gas fuel	51 mg/Nm^3 (25 ppm)	70 mg/Nm^3 (34 ppm)	Fuelled by natural gas GT operations, Dry Low Emissions (DLE). NO_x expressed as nitrogen dioxide (NO_2) based on 15% O_2, dry condition, temperature 0°C and standard air pressure 1013 hPa in the exhaust.
NO_x, 1-hour average, diesel fuel	86 mg/Nm^3 (42 ppm)	90 mg/Nm^3 (44 ppm)	Diesel fuelled GT operations, water-injected for NO_x management. NO_x expressed as nitrogen dioxide (NO_2) based on 15% O_2, dry condition, temperature 0°C and standard air pressure 1013 hPa in the exhaust.
Carbon monoxide (CO) 1-hour average, natural gas fuel	12.5 mg/Nm^3 (10 ppm)	N/A	NSW Gov. (2020a) prescribes no limits for CO for GTs. 15% O_2, dry condition, temperature 0°C and standard air pressure 1013 hPa in the exhaust.
CO, 1-hour average, diesel fuel	63 mg/Nm^3 (50 ppm)	N/A	NSW Gov. (2020a) prescribes no limits for CO for GTs. 15% O_2, dry condition, temperature 0°C and standard air pressure 1013 hPa in the exhaust.
Particulate Matter 10 (PM_{10}), natural gas fuel	5 mg/Nm^3	N/A	
Particulate Matter 10 (PM_{10}), Diesel fuel	10 mg/Nm^3	50 mg/Nm^3 (Total Particles)	

Notes:
1. *NSW Government, Protection of the Environment Operations (Clean Air) Regulation 2010*

The NSW *Protection of the Environment Operations Act 1997* (POEO Act) is the primary piece of legislation for the regulation of potential pollution impacts associated with 'scheduled activities' in NSW. Scheduled activities are those defined in Schedule 1 of the POEO Act. Clause 17 (Electricity generation) and applies to electricity plant that uses a gas turbine and which is situated in the metropolitan area or the local government areas (LGA) of Port Stephens, Maitland, Cessnock, Singleton, Wollondilly or Kiama. As the Proposal Site is in the LGA of Cessnock, the Proposal is therefore a scheduled activity.

The NSW Clean Air Regulation contains provisions for the regulation of air emissions to air from wood heaters, open burning, motor vehicles and fuels and industry. The air emissions limits relevant for the Proposal are the 'Group 6 Standard' for scheduled premises; they are listed in Table 15.2 (Comparisons with the Proposal data are provided in Table 15.1).

Table 15.2: NSW Group 6 Standard for scheduled premises: air emissions limits for electricity generation

Substance	Natural Gas	Diesel
Solid Particles (Total)	--	50 mg/m^3
Nitrogen dioxide (NO_2)	70 mg/m^3	90 mg/m^3
Reference conditions	Dry, 273 K (0°C), 1013 hPa	

The NSW EPA (2016) ambient air quality assessment criteria relevant to the assessment; i.e., the air pollutants identified for this assessment, are listed in Table 15.3.

Table 15.3: NSW EPA air quality impact assessment criteria

Substance	Statistic	Concentration
Main air pollutants – from EPA (2016) Table 7.1, impact assessment criteria, inclusive of background levels Gas volumes expressed at (approximately) 25°C and 1 atmosphere (101.325 kPa).		
Sulphur dioxide (SO_2)	Maximum 10-minute average	712 µg/m^3
	Maximum 1-hour average	570 µg/m^3
	Maximum 24-hour average	228 µg/m^3
	Maximum annual average	60 µg/m^3
Nitrogen dioxide (NO_2)	Maximum 1-hour average	246 µg/m^3
	Maximum 24-hour average	62 µg/m^3
Photochemical oxidants (as ozone)	Maximum 1-hour average	214 µg/m^3
	Maximum 4-hour average	171 µg/m^3
Particulate Matter as $PM_{2.5}$	Maximum 24-hour average	25 µg/m^3
	Maximum annual average	8 µg/m^3
Particulate Matter as PM_{10}	Maximum 24-hour average	50 µg/m^3
	Maximum annual average	25 µg/m^3
Carbon monoxide (CO)	Maximum 15-minute average	100 mg/m^3
	Maximum 1-hour average	30 mg/m^3
	Maximum 8-hour average	10 mg/m^3
Volatile Organic Compounds (VOCs) – from EPA (2016) Table 7.2a, principal toxic air pollutants, project only contributions. Gas volumes expressed at 25°C and 1 atmosphere (101.325 kPa).		
Acrolein	99.9th percentile 1-hour average	0.42 µg/m^3
Formaldehyde	99.9th percentile 1-hour average	20 µg/m^3

Substance	Statistic	Concentration
Polycyclic Aromatic Hydrocarbons (PAH) as Benzo(a)Pyrene (B(a)P)	99.9th percentile 1-hour average	0.4 µg/m^3

Emissions estimates for PAHs from the Proposal were assumed to be 100 percent B(a)P (EPA, 2016). No further detailed information about gas turbine emissions of PAHs was provided in DEWHA (2008) or U.S. EPA (2004).

Meteorological modelling

The Air Pollution Model (TAPM) developed by the CSIRO was used to generate hourly-varying surface and upper-air meteorological data over the Proposal study grid, using surface measurements from the Department of Planning Industry and Environment's (DPIE) nearest air monitoring station at Beresfield as input. Modifications were made to default land use parameters for some grid cells to better reflect the local land use identified using aerial imagery, especially along Swamp Creek. Hourly average wind speed and wind direction observational data from the DPIE Beresfield monitoring station were used in 'data assimilation' mode, to force TAPM to produce meteorological results for Beresfield very similar to the observations. The surface winds produced by TAPM for Beresfield were compared with the observational data to confirm proper assimilation. Subsequently these data were then used as inputs to Calmet, which was used to produce an hourly-varying, three-dimensional, meteorological dataset for the air quality study grid.

Calmet results for surface winds were then extracted at the Proposal Site and compared with the measured winds at Beresfield to confirm that the wind data produced by the model over the whole grid was of sufficient quality.

Calpuff modelling

Calpuff is a dispersion model for the simulation of the effects of varying meteorological conditions on pollutant transport. The model accounts for effects such as widespread variations in weather conditions, dispersion over varying terrain and type of surface (e.g. land, water), plume fumigation and low wind speed dispersion (EPA, 2016). The model includes algorithms for air pollutant dispersion including the use of coefficients to account for atmospheric turbulence-based dispersion.

The model was also calibrated to take into account the airborne wake effects that would be caused by the layout and heights of the Proposal's infrastructure, including the proposed turbine exhaust stacks.

The study grid comprised 9,600 grid receivers and the 16 discrete receivers in accordance with the requirements of EPA (2016). Grid resolution was 250 m, with study grid size 20 km north-south and 30 km east-west.

Peak-to-mean ratio

The Calpuff modelling was limited to hourly average data. The main simulation involved the processing of a simulated year of meteorological and air dispersion data, or 8,760 hours of simulations. Outputs from the modelling were therefore also limited to hourly averages, such as air pollutant concentrations. Some of the EPA (2016) air quality assessment criteria had sub-hourly averaging periods, as such a method was needed to:

- Convert hourly-average GLCs due to point source emissions to a sub-hourly average GLC
- Convert hourly-average ambient air pollutant concentrations, which could be from any source type (point, volume, etc.), to a sub-hourly average GLC.

A detailed explanation of the model parameters and algorithms used is provided in Appendix K.

NO_x to NO_2 Conversion: Ozone Limiting Method

Using a technique known as the Ozone Limiting Method (OLM), the NO_2 concentration at a point, in any hour, is determined through a formula that converts dispersed NO_x to ground level concentrations of NO_2 using hourly background NO_2 and O_3 data. The method assumes all the available Ozone (O_3) reacts with NO using all available (ambient) O_3 or NO. EPA (2016) warns the method assumes an instant reaction whereas in the atmosphere, the reaction takes place over a number of hours.

The background NO_2 and O_3 data used in the calculations for this assessment were obtained from the DPIE Beresfield monitoring station. A more detailed explanation of the OLM, including the mathematical formulas, is provided in Appendix K.

Methodology – summary

Taken in combination, the meteorological and dispersion modelling techniques outlined above, along with the mathematical conversion formulas, provide a means of deriving meaningful results from complex chemical reactions and interactions in the atmosphere. The methodology aims to understand and predict how these interactions and reactions may be influenced by the Proposal, and what the impacts of the Proposal might be on ground level concentrations of pollutants that might present a risk to human or ecological health. The assessment has built a predictive model of emissions concentrations and dispersal resulting from the Proposal. The results of this assessment are provided in Section 15.3.

15.2 Existing environment

15.2.1 Local setting

The terrain in the immediate vicinity of the Proposal Site is relatively flat, following the Swamp Creek river valley to the north-east towards Maitland. There are some hilly areas to the north-west and south-east. A hill 100 m in height lies 7.7 km south-southwest of the Proposal Site. Figure 15.1 shows the location of the Proposal Site (yellow cross), terrain elevation contours (orange and green) and the 16 discrete receiver locations identified for assessment (green).

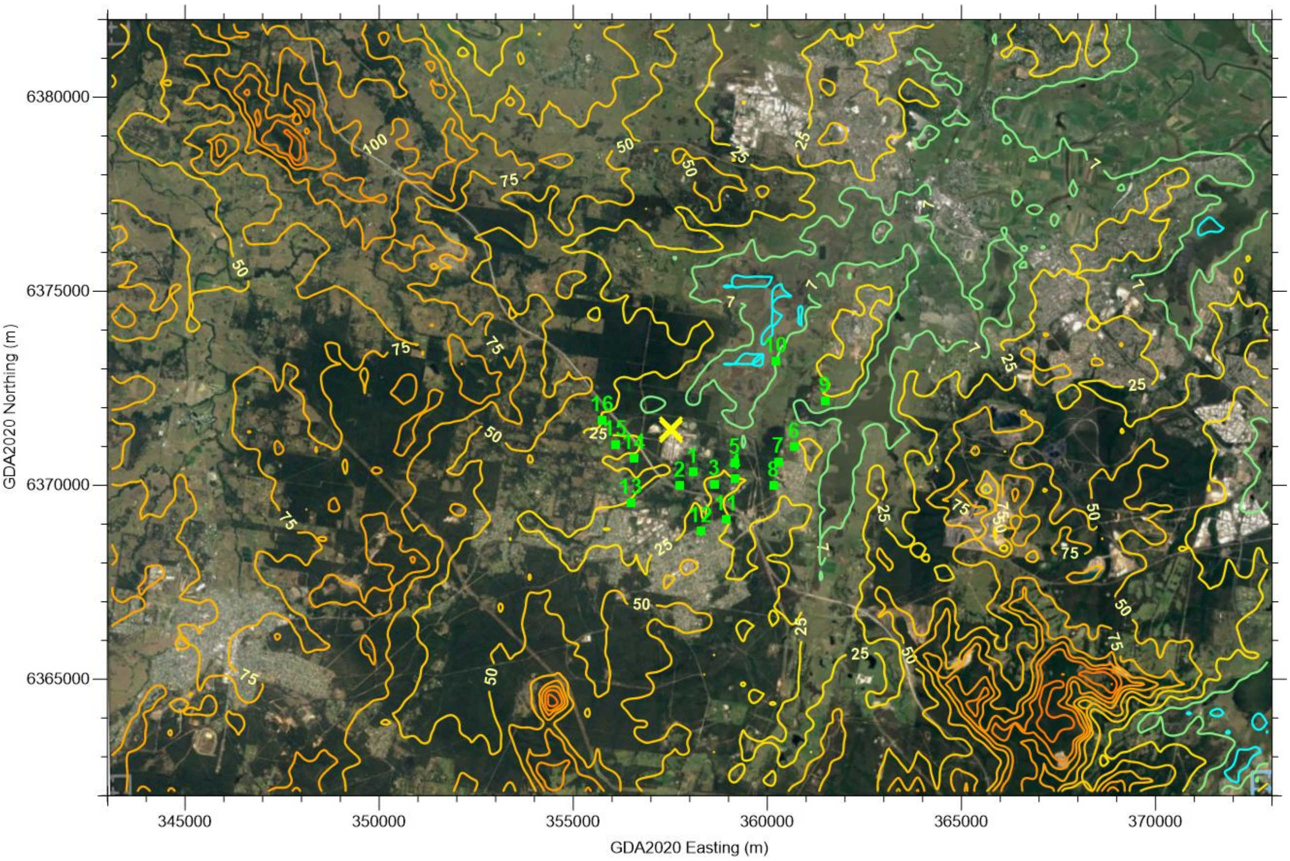


Figure 15.1: Air quality study area with terrain elevation contours and sensitive receivers

15.2.2 Sensitive receivers

Potentially sensitive receiver locations, mainly isolated residential residences, were identified using aerial imagery (listed in Table 15.4 and shown on Figure 15.1). These sensitive receivers were used to compare predicted GLCs of airborne pollutants against regulatory criteria, because of their proximity to the Proposal site. Hence, they were considered to be representative of locations that would experience worst-case air quality impacts due to the Proposal.

Table 15.4: Sensitive receiver locations (indicative) identified for assessment

Number	Easting (m)	Northing (m)	Description
1	358086	6370341	Residence
2	357748	6369983	Residence
3	358636	6370028	Residence
4	359178	6370182	School; TAFE NSW – Kurri Kurri
5	359161	6370579	Farmhouse; Bowditch Ave.
6	360689	6370984	Residence
7	360286	6370603	Residence
8	360157	6369986	Residence
9	361486	6372171	Residence
10	360220	6373188	Farmhouse
11	358945	6369119	Residence
12	358289	6368815	School; Kurri Kurri High School
13	356482	6369542	Residence; Amarillo
14	356566	6370702	Residence; Bishops Bridge Road
15	356089	6371047	Residence
16	355748	6371678	Residence

15.2.3 Local meteorology

Meteorological data collected from the DPIE’s Beresfield air quality monitoring station were analysed in order to identify a representative year for this assessment (NSW Gov., 2021). The annual wind patterns for each year from 2015 to 2019 are shown by the wind roses in Figure 15.2. The most common winds in the area are from the west-northwest. This pattern of winds is common for the Lower Hunter Valley and reflects the influence of the northwest to southeast alignment of the Hunter Valley. Wind patterns were similar in all five years. This suggests that wind patterns do not vary significantly from year to year, and potentially the data from any of the years presented could be used as a representative year for assessment purposes.

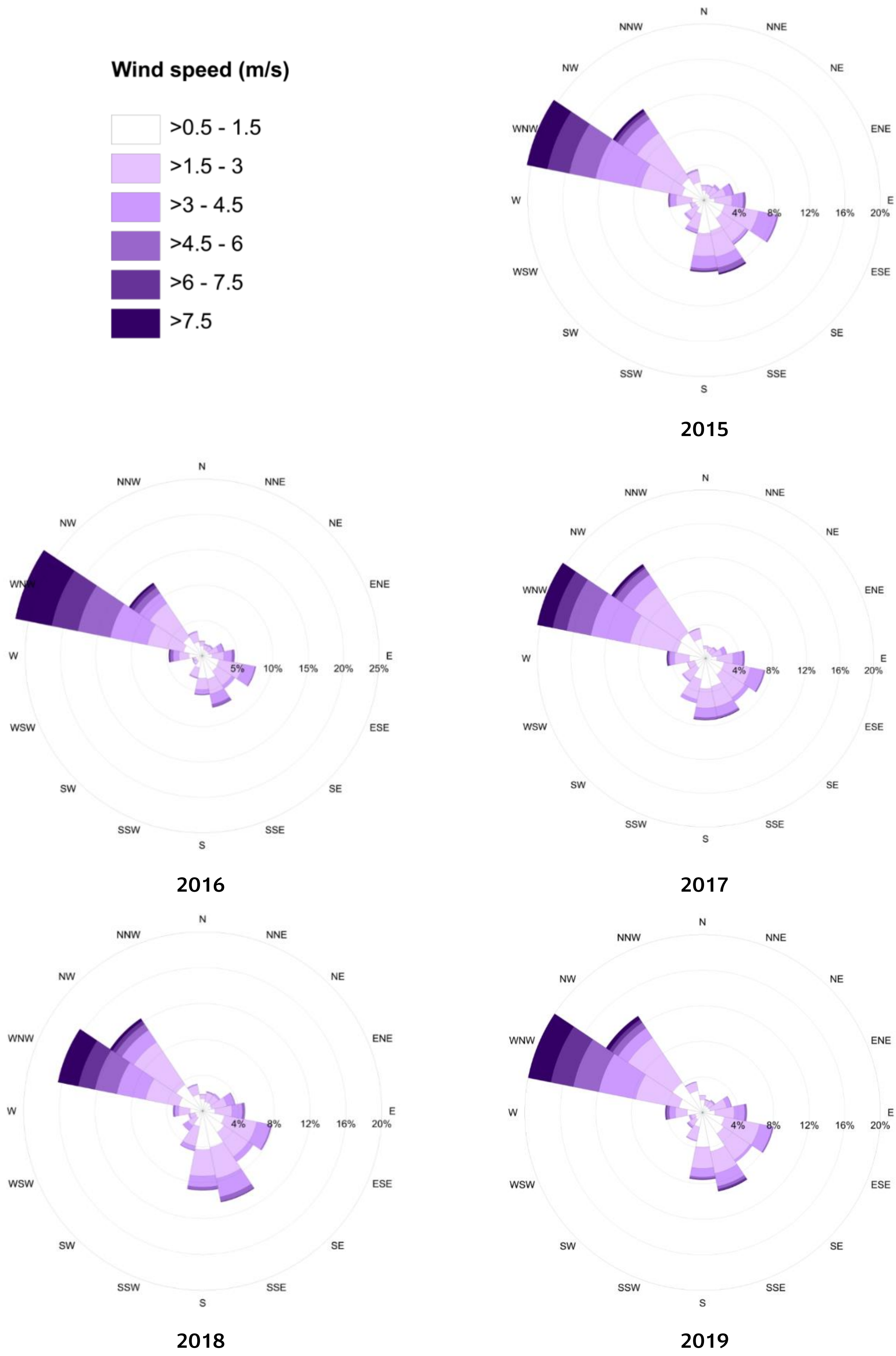
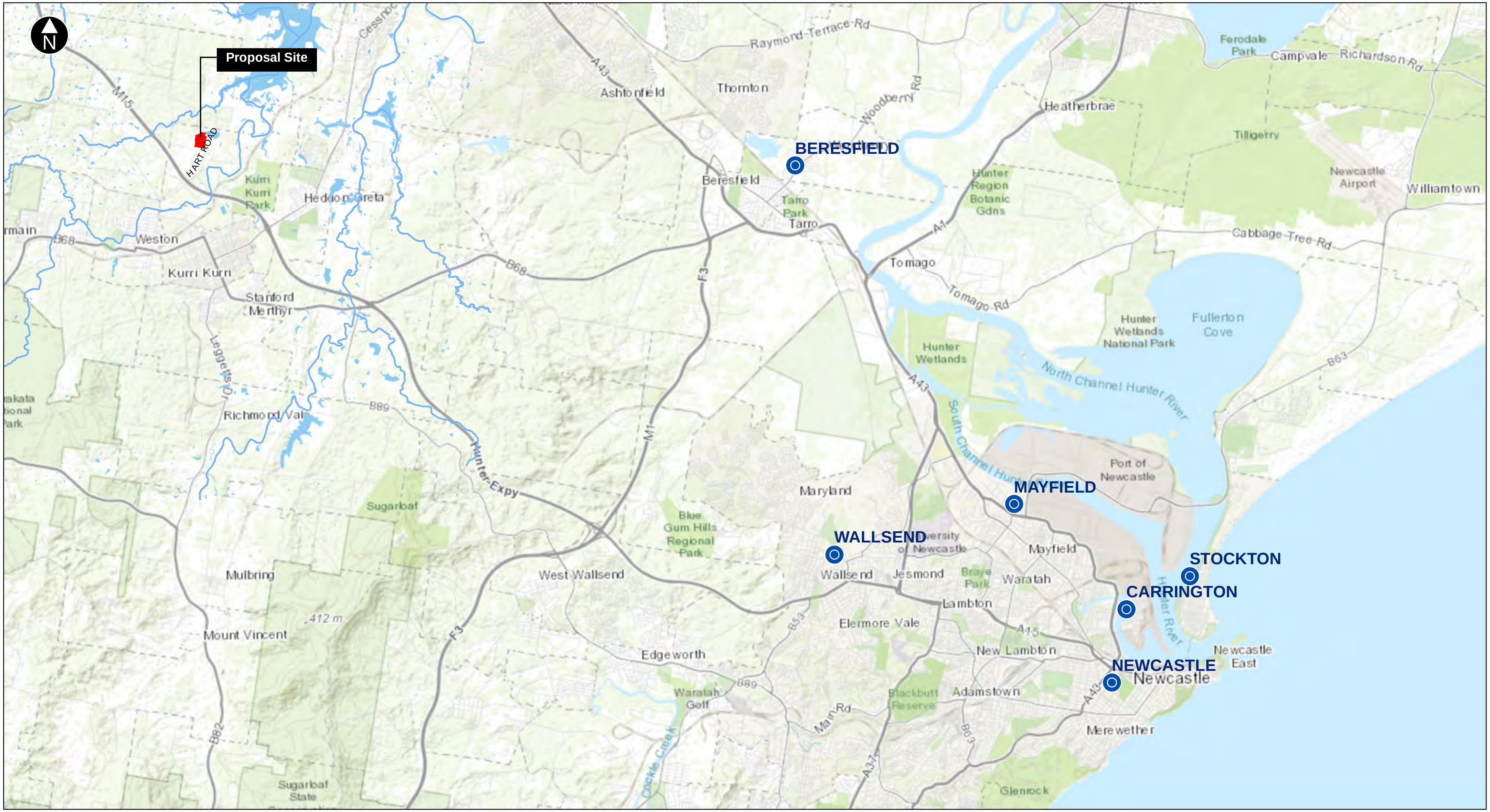


Figure 15.2: Annual wind roses: EPA Beresfield 2015-2019

15.2.4 Existing air quality

The DPIE established a network of monitoring stations across NSW to understand current air quality conditions and impacts, and to help identify programs to improve air quality (NSW Gov., 2021). The nearest DPIE stations to the Proposal site are illustrated in Figure 15.3 (NSW Gov., 2021).

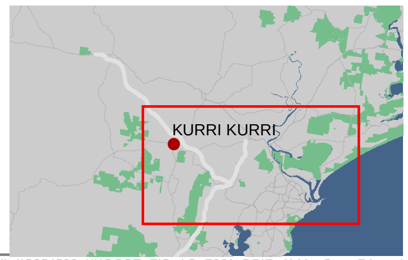


Proposal Site	DPIE air monitoring stations in Lower Hunter
Recreation areas	
Waterbodies	

0 5 10 km

1:150,000 at A4

Coordinate System: GDA2020 MGA Zone 56



Data sources:
Jacobs
NSW Spatial Services
DPIE (NSW Gov., 2021; 26 Jan., 2021)

Figure 15-3 Map of DPIE air monitoring stations in Lower Hunter

snowy hydro renewable energy Jacobs

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Being the closest air quality monitoring station to the Proposal Site, DPIE data from Beresfield were examined and compared with air quality (monitoring) standards to describe existing air quality conditions for key air pollutants relevant to this assessment, summarised in Table 15.5 and Table 15.6. Carbon monoxide (CO) is not measured at Beresfield, so the CO data used for this assessment were obtained from the next nearest station, Newcastle. Newcastle and Beresfield air quality monitoring data are affected more by emissions from road vehicles than the Kurri Kurri locality, so the key air pollutant levels at Kurri Kurri are expected to be lower than at Beresfield or Newcastle.

Table 15.5: Summary of measured parameter concentrations: DPIE Beresfield and Newcastle

Parameter	Statistic and criterion	2015	2016	2017	2018	2019
Beresfield						
SO_2	Max. 1-hour average; 570 $\mu g/m^3$	215	86	141	183	178
	Max. 24-hour average; 228 $\mu g/m^3$	21	21	21	18	24
	Annual average; 60 $\mu g/m^3$	2.6	2.6	5.2	5.2	5.2
$PM_{2.5}$	Max. 24-hour average; 25 $\mu g/m^3$	26	28	19	25	101
	Number of days above 25 $\mu g/m^3$	1	1	0	0	23
	Annual average; 8 $\mu g/m^3$ (1)	7.4	7.4	7.6	8.7	12.2
NO_2	Max. 1-hour average; 246 mg/m^3	92	77	75	75	105
	Annual average; 62 mg/m^3	17	15	16	17	15
O_3	Max. 1-hour average; 214 mg/m^3	151	167	163	210	247
	Max. 4-hour average; 171 mg/m^3	131	133	155	175	210
Newcastle						
CO	Max. 1-hour average; 30 mg/m^3	2.0	2.4	1.6	1.4	2.2
	Max. 8-hour average; 10 mg/m^3	1.7	1.6	1.3	1.2	1.7

Note:
1. Maximum annual average introduced by EPA for 2017 onwards

Table 15.6: Summary of measured parameter concentrations: DPIE Beresfield and Newcastle (CO only)

Parameter	Description
Carbon monoxide (CO)	Results show that CO concentrations have been consistently below EPA (2016) impact assessment criteria. The trend in 8-hourly average CO has been slightly downwards since 2009 (NSW Gov., 2020a).
Sulphur dioxide (SO_2)	SO_2 concentrations in the Lower Hunter are likely influenced by industrial sources in the Hunter Valley, such as coal-fired power stations. However, at Beresfield, the concentrations have been consistently below the EPA (2016) impact assessment criteria each year. Analysis of the SO_2 trends in the Lower Hunter since 2009 shows no clear change in SO_2 levels over the past decade (NSW Gov., 2020a).
Particulate matter as PM_{10} and $PM_{2.5}$	Existing levels of airborne particulate matter are high and exceed the air quality (monitoring) standards every year. The majority of the high PM_{10} and $PM_{2.5}$ levels were due to the effects of drought including dust storms, and smoke from bushfires and controlled burns (NSW Gov., 2020a). In particular, very high concentrations of PM_{10} and $PM_{2.5}$ were experienced in the last months of 2019 due to bushfires in the Lower Hunter Valley. Emissions from industry and road vehicles in the Newcastle and Lower Hunter regions also contribute to these high levels.

Parameter	Description
Oxides of Nitrogen	NO_2 is the pollutant of interest for comparison with the air quality criteria. The maximum NO_x concentrations are associated with the lowest NO_2 concentrations. Typically, as the NO_x concentration increases the NO_2/NO_x fraction decreases to a minimum. The NO_2/NO_x ratios for DPIE Beresfield resulted in the average NO_2/NO_x fraction as 68%. For the highest NO_x concentrations greater than 300 µg/m^3 the NO_2 concentration is less than 20%.
Nitrogen dioxide (NO_2) and ozone	NO_2 concentrations have been consistently below EPA (2016) impact assessment criteria. Analysis of the trends for NO_2 show no clear change since 2009 (NSW Gov., 2020a). Predictions of O_3 concentrations require a regional, photochemical modelling, which was outside the scope of this assessment. While O_3 was not required to be assessed for the Proposal, industrial emissions of NO_x and other pollutants contribute to the formation of O_3. As such, results show that exceedances of the EPA (2016) criteria for O_3 is a more significant air quality issue than for NO_2, and demonstrate why NO_x minimisation by industry is important even though exceedances of the NO_2 criteria are unlikely–at least in the Lower Hunter. Analysis of the trend data for O_3 (NSW Gov., 2020a), and more recent monitoring data, shows an increase in O_3 levels. The most likely explanation is emissions from bushfires in 2018-2019 (NSW Gov., 2020b; NSW Gov., 2020c).

Hydrocarbons (VOCs) for assessment

The selection of VOCs for assessment was by the quantitative risk assessment of gas turbine air emissions data. The selected VOCs were:

- For combustion of natural gas in gas turbines: Formaldehyde and Acrolein
- For combustion of diesel fuel by gas turbines: PAHs as B(a)P and Formaldehyde.

The NSW EPA (2016) does not require background levels of individual VOCs to be included as part of cumulative impact assessments. Consequently, there is no current data available for existing or background concentrations of VOCs in the vicinity of the Proposal Site.

15.2.5 Summary

From the above assessment, the following conclusions were made in relation to the existing air quality and meteorological conditions in the vicinity of the Proposal site:

- Wind patterns in the vicinity of the Proposal are characteristic of the Lower Hunter Valley, with the prevailing winds being from the west-northwest
- Measured CO, NO_2 and SO_2 concentrations have been consistently below EPA (2016) air quality impact assessment criteria
- Measured O_3 occasionally exceed assessment criteria nearly every year, typically due to emissions from bushfires and controlled burns
- Measured $PM_{2.5}$ levels increased across NSW and the Hunter region from 2017 to 2019 due to dust from the widespread intense drought, and smoke from bushfires and hazard reduction burning. These events adversely influenced air quality with multiple days observed when $PM_{2.5}$ concentrations exceeded EPA assessment criteria.

15.3 Air quality impact assessment

15.3.1 Impacts to air quality during construction

Construction of the Proposal would generate fugitive emissions in the form of:

- Dust from handling of soils and exposed excavations, including the site excavations for the gas turbine facility and switchyard, construction of on-site access roads, overall site grading activities and vehicle movements
- Emissions generated by combustion of fuel from construction plant including small volumes of particulates, carbon monoxide, carbon dioxide, hydrocarbons and nitrogen oxides.

Generation of dust during construction can be effectively controlled through environmental management measures. The volumes and types of emissions that are likely to be generated from the construction activities associated with the Proposal are considered to be relatively minor and would have a negligible impact on the local air quality.

Air quality impacts due to construction of the plant are expected to be insignificant and temporary. No odour impacts are anticipated. Commonly used dust control measures will be used to minimise air pollutant emissions. The Proposal site has good separation from sensitive receivers such as residences and as such this would have negligible impact during the construction phase.

Measures to manage dust generation and construction plant emissions would be defined in the construction environmental management plan for the Proposal.

15.3.2 Impacts to air quality during operation

Operation of the Proposal would generate emissions from the combustion of natural gas and diesel fuel. Both of these fuel sources generate the following emissions:

- Carbon monoxide (CO)
- Carbon dioxide (CO_2)
- Nitrogen oxides (NO_x)
- Sulphur oxides (SO_x)
- Suspended particulate matter (such as PM_{10} and $PM_{2.5}$)
- Unburnt hydrocarbons and other volatile organic compounds (VOCs).

Results from the Calpuff modelling for GLCs are provided for the Proposal's maximum load case (i.e. steady state operation at the nominated 100 per cent load condition for both gas turbines), which was determined by sensitivity analysis with Calpuff to be the worst-case operating scenario for the Proposal. A minimum load case, estimated at approximately 50 per cent load, was also tested by modelling to determine the air quality sensitivities.

The Proposal is seeking approval for a capacity factor of up to 10 per cent on natural gas and up to two per cent on diesel (providing a combined capacity factor of 12 per cent) in any given year. However, it is expected that likely operations would result in a capacity factor of 2 per cent in any given year. However, modelling of continuous emissions from the Proposal was undertaken to test every hour of an annual meteorological simulation – a conservative approach to the assessment. Also, annual average GLCs were reported as calculated from the continuous emissions estimates, i.e. not reduced to match the 10 per cent and 2 per cent capacity factors for natural gas and diesel fuel respectively. The reason for this was the annual averages were very small, and immaterial to the outcomes of the assessment.

A Level 2 air quality impact assessment was carried out for SO_2, NO_2, $PM_{2.5}$ and CO using contemporaneous measurements and model data in accordance with the EPA (2016) modelling assessment guideline. Assessments for these substances were conducted using the data and steps listed in the following points:

- Ambient air monitoring data (hourly averages) included at least one year of continuous measurements and were contemporaneous with the meteorological data used for dispersion modelling
- The dispersion model prediction for each receiver, for each hour, was added to the corresponding estimate for the background concentration in that hour to obtain the total concentration
- The maximum total concentrations in each hour, for each receiver, were compared with criteria for the substances tested.

For Level 2 assessment of the toxic air pollutants, the predicted (modelled) 99.9th-percentile hourly average concentrations (without background estimates) were compared with the impact assessment criteria at and beyond the Proposal Site boundaries (in this case at all 9,600 grid receivers plotted by the model, and 16 discrete receiver locations).

The detailed Calpuff results can be seen in Appendix K, tabulated and as contour plots in accordance with EPA (2016). A summary of the modelled results for parameters emitted during operation of the Proposal is provided below.

Calpuff results for carbon monoxide

The Calpuff results for cumulative, ambient CO concentrations, due to emissions from the Proposal plus estimates for background CO, are low in comparison to the EPA (2016) impact assessment criteria. The results indicate there is no significant risk of air quality impacts due to CO emissions from the Proposal when operating at maximum load, whether fuelled by natural gas or diesel, at any time of the year.

Calpuff results for sulphur dioxide

The Calpuff results for cumulative, ambient SO_2 concentrations due to emissions from the Proposal, including estimates for background SO_2, are low in comparison to the EPA (2016) impact assessment criteria. The results indicate there is no significant risk of air quality impacts due to SO_2 emissions from the Proposal when operating at maximum load, whether fuelled by natural gas or diesel, at any time of the year.

Calpuff results for $PM_{2.5}$

The Calpuff results for cumulative, ambient $PM_{2.5}$ concentrations due to emissions from the Proposal plus estimates for background $PM_{2.5}$ are small (maximum 24-hour average) and very small (annual averages), relative to the assessment criteria. The maximum background 24-hour average $PM_{2.5}$ level is just less than its criterion (25 $\mu g/m^3$), so small additions at any point may lead to the criterion being just exceeded. The annual average $PM_{2.5}$ level already exceeds the criterion (8 $\mu g/m^3$); the Proposal contributions represent very small additions to this quantity. The only potential for the Proposal to cause an exceedance of EPA criteria would be when the background levels are already approaching the criteria. Under these conditions, the contribution from the Proposal, if operating at the time, would be very small.

Concentrations of $PM_{2.5}$, including with potential contributions from the Proposal, would therefore continue to be within the range of historically measured fluctuations in maximum concentrations for the region. Higher measured 24-hour average $PM_{2.5}$ concentrations (at Beresfield) over the five year period from 2015–2019 were a consequence of bushfire smoke and raised dust (the latter due to periods of higher wind speeds).

Table 15.7 provides for reference, a statistical summary of the $PM_{2.5}$ measurements at Beresfield over 2015 to 2019. Over this five year period, exceedances of the $PM_{2.5}$ criteria occurred in all years except 2017, for the reasons just explained (bushfire smoke, raised dust). All the predicted increases due to the Proposal are insignificant in relation to these background concentrations.

Table 15.7: Summary of measured $PM_{2.5}$ concentrations: DPIE Beresfield ($\mu g/m^3$)

Statistic and criterion	2015	2016	2017	2018	2019
Max. 24-hour average; 25 $\mu g/m^3$	26	28	19	25	101
Number of days above 25 $\mu g/m^3$	1	1	0	0	23
Annual average; 8 $\mu g/m^3$	7.4	7.4	7.6	8.7	12.2

The results for particulate matter were not assessed as PM_{10} as nearly all the particles are expected to be in the $PM_{2.5}$ size range (AG, 2008). Also, the assessment of particulate emissions as $PM_{2.5}$ was more conservative than PM_{10} as the $PM_{2.5}$ standards are the more stringent.

The background and contribution of the Proposal to the 24-hourly average $PM_{2.5}$ at the most affected sensitive receiver is shown in Figure 15.5, for diesel fuel operation. $PM_{2.5}$ emissions are similar for natural gas fuel operation. Background (EPA Beresfield) concentrations clearly dominate the results and are below the NSW Criterion.

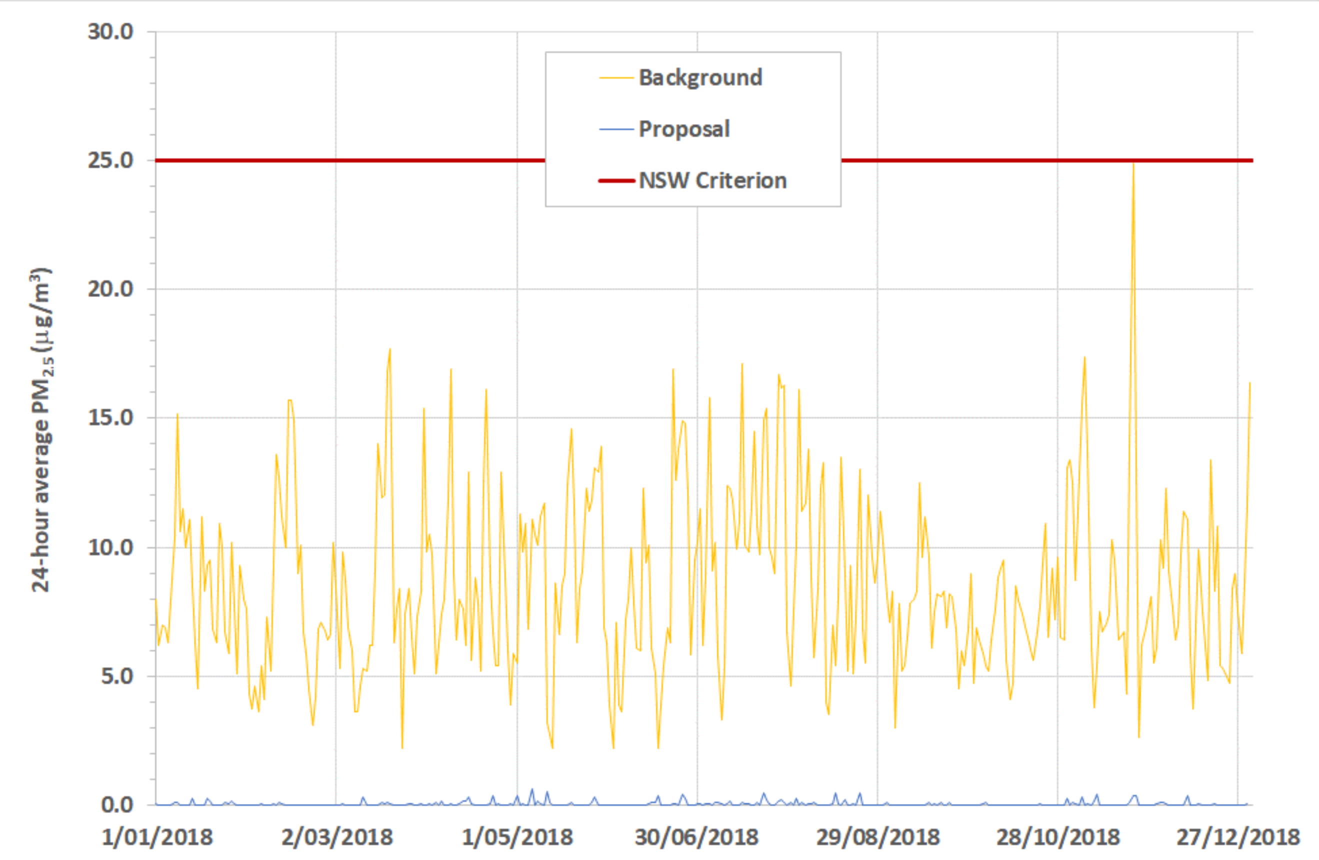


Figure 15.4: 24-hourly average $PM_{2.5}$ background and modelled Proposal concentrations for worst case sensitive receiver (diesel-fuelled case)

Calpuff results for nitrogen dioxide

The results for NO_2 were determined using the Ozone Limiting Method (refer Section 15.1.2), which combined the Calpuff results for NO_x dispersion at ground level with EPA Beresfield monitoring data for NO_2 and O_3. Using this method, there were no predicted exceedances of the EPA (2016) impact assessment criteria for NO_2.

Background and modelled Proposal hourly average NO_2 concentrations at the most affected sensitive receiver are shown in Figure 15.5, for diesel fuel operation. NO_2 emissions are similar for natural gas fuel operation. Background (EPA Beresfield) concentrations clearly dominate the results and are well below the NSW Criterion.

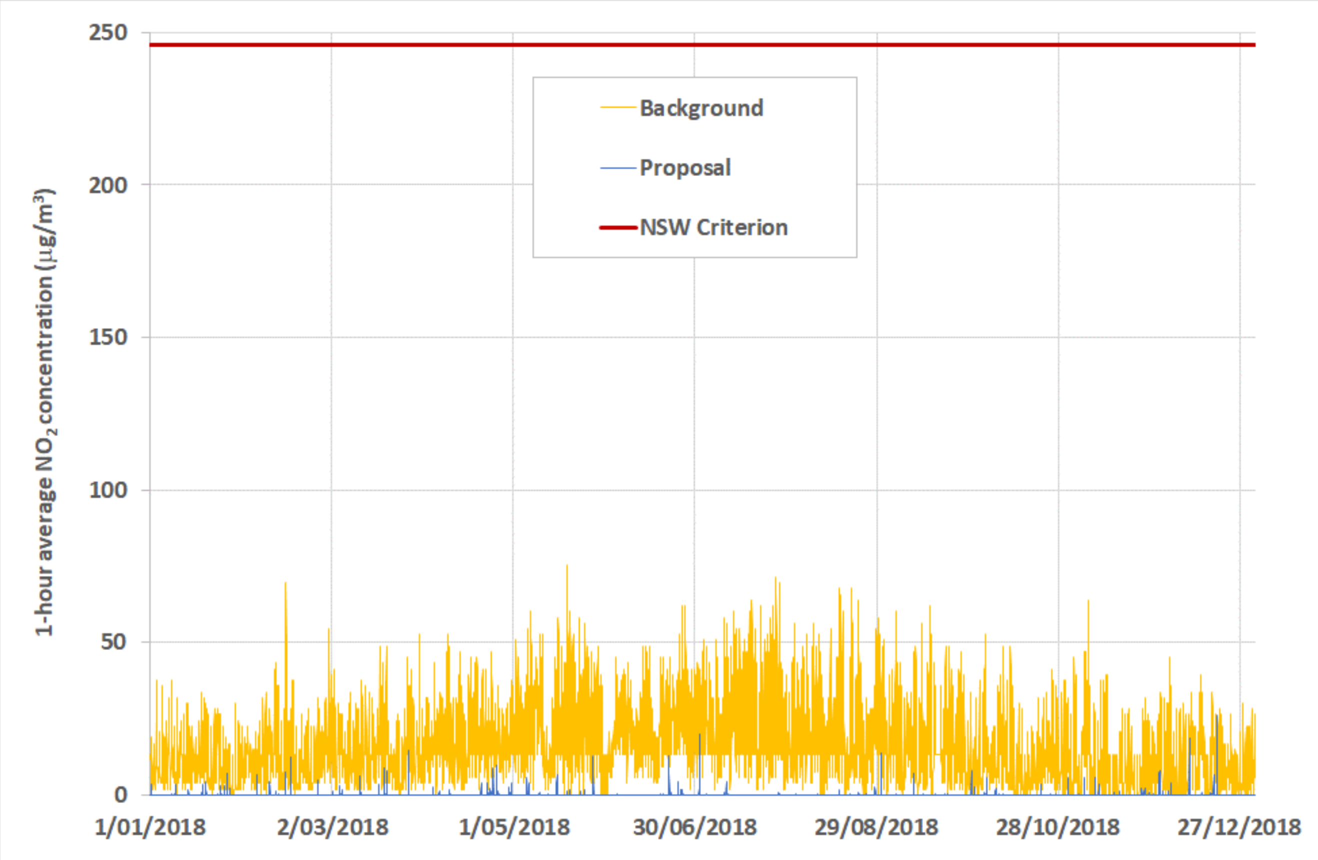


Figure 15.5: Hourly average NO_2 background and modelled Proposal concentrations for worst case sensitive receiver (diesel-fuelled case)

Annual NO_x emission can be of interest for a gas turbine proposal because of the potential to contribute to regional ozone formation. This regional ozone is created in the presence of sunlight and background air pollutants by the air emissions from many sources. Assuming a capacity factor of up to 10 per cent of each year on natural gas fuel and two per cent on diesel fuel, the annual NO_x emission is calculated to be 139 tonnes per annum.

Calpuff results for hydrocarbons (VOCs): formaldehyde

There were no predicted exceedances of the EPA (2016) impact assessment criteria for formaldehyde. Background formaldehyde concentrations are significantly higher than predicted contributions due to the Proposal.

Calpuff Results for hydrocarbons (VOCs): acrolein and B(a)P

There were no predicted exceedances of the EPA (2016) impact assessment criteria for acrolein (0.42 $\mu g/m^3$) and B(a)P (0.4 $\mu g/m^3$). The background acrolein concentrations are significantly higher than predicted contributions due to the Proposal. Proposal contributions of B(a)P are greater than background, but overall, the B(a)P concentrations are very low, in the order of one per cent of the criteria.

Assessment summary – air quality

The key air pollutants associated with the Proposal are: carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matter as $PM_{2.5}$ and the hydrocarbons or Volatile Organic Compounds (VOCs): formaldehyde and acrolein when the power station is fuelled by natural gas; and formaldehyde and Benzo(a)pyrene (B(a)P) when fuelled by diesel.

In relation to air emissions from the Proposal, the key air quality issues identified were due to existing high background levels of $PM_{2.5}$ and O_3, while measured background concentrations of CO, NO_2 and SO_2 have been consistently below the EPA (2016) air quality impact assessment criteria.

The key outcomes of the air quality assessment, from model predictions for selected sensitive receivers, showed that:

- The Proposal will meet NSW Government requirements for air pollutant concentrations in the exhaust gases
- Operation of the Proposal will lead to small increases, relative to air quality criteria, in ambient (ground level) concentrations of the air pollutants: CO, NO_2, SO_2, $PM_{2.5}$ and the VOCs: formaldehyde, acrolein and PAHs as B(a)P
- The air pollutants of concern are those where background levels are already high; i.e., NO_2 (because O_3 levels are high) and $PM_{2.5}$. Modelling of the Proposal's likely emissions added very small amounts of NO_2 and $PM_{2.5}$ to the already high background levels.

Based on modelling, increases in NO_2 concentrations due to the Proposal are unlikely to cause exceedances of NO_2 criteria. However, O_3 background levels are high, and any additional NO_x emissions represent an increase to regional NO_x that contribute to the formation of O_3 in the wider region. A detailed photochemical modelling study was outside the scope of this study. However, it would be reasonable to assume the NO_x emissions as a result of the Proposal would have the effect of slightly reducing O_3 levels in its immediate vicinity (O_3 destruction), but would contribute to a very slight increase in regional O_3 levels.

The model results show that $PM_{2.5}$ contributions due to the Proposal would be negligible relative to air quality criteria. Concentrations of $PM_{2.5}$, including with potential contributions from the Proposal, would continue to be within the range of historically measured fluctuations in maximum concentrations for the region. This means that in a year not affected by bushfires, emissions from the Proposal are very unlikely to cause exceedances of $PM_{2.5}$ criteria. In a year affected by bushfires, measurements of $PM_{2.5}$ will be representative of the high concentrations due to bushfire smoke.

The assessment has demonstrated that the Proposal's operation, whether fuelled by natural gas or diesel, is not expected to cause adverse air quality impacts in the vicinity of the Proposal Site nor in the wider Lower Hunter region. This conclusion was based on modelling procedures undertaken in accordance with *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016). The implementation of 'best practice' gas turbine engineering technology for the Proposal, such as using Dry Low Emission (DLE) combustion system to minimise NO_x emissions (see Chapter 2.2.5), will be implemented.

15.4 Greenhouse gas assessment

15.4.1 Greenhouse gas assessment methodology

The methodology for assessment of greenhouse gas impacts arising from the Proposal is summarised as follows:

- Creating an inventory of likely greenhouse gas emissions associated with the Proposal to determine the scale of the emissions and a baseline from which to develop and deliver greenhouse gas reduction options. Emissions are then aggregated into the equivalent emissions of carbon dioxide. The prominent greenhouse gases, and their most common sources include:
  - Carbon dioxide (CO_2) – by far the most abundant, primarily released during fuel combustion

- Methane (CH_4) – as fugitive emissions from gas production and transportation
- Nitrous oxide (N_2O) – from industrial activity, fertiliser use and production
- Hydrofluorocarbons (HFCs) – commonly used as refrigerant gases in cooling systems
- Perfluorocarbons (PFCs) – used in a range of applications including solvents, medical treatments and insulators
- Sulphur hexafluoride (SF_6) – used as a cover gas in metal smelting, and as an insulator in high-voltage electrical switch gear.

▪ Determining an assessment boundary which defines the scope of greenhouse gas emissions and the activities to be included in the assessment

▪ Emissions factors are then used to determine emissions of greenhouse gases from processes or activities, where it is impractical to directly measure (or model) emissions.

The aforementioned greenhouse gas inventory for this assessment is calculated in accordance with the principles of the Greenhouse Gas Protocol (GHG Protocol). The greenhouse gas emissions that form the inventory can be split into three categories known as 'Scopes'. Scopes 1, 2 and 3 are defined by the GHG Protocol and are summarised as follows:

▪ Scope 1 – Direct emissions from sources that are owned or operated by a reporting organisation (examples – combustion of diesel in company owned vehicles or used in on-site generators)

▪ Scope 2 – Indirect emissions associated with the import of energy from another source (examples – importation of electricity or heat)

▪ Scope 3 – Other indirect emissions (other than Scope 2 emissions) which are a direct result of the operations of the facility but from sources not owned or controlled by that facility's business (examples include business travel (e.g. by air or rail) and usage of the facility's product by other businesses).

Additionally, consideration of current NSW, national and international policies and regulatory frameworks relating to greenhouse gas emissions have been applied for the assessment. These policies are listed in Table 15.8.

Table 15.8: International, Commonwealth and State Policy settings in relation to Greenhouse gas emissions

Policy setting	Policy
International	Paris Climate Conference COP21 The Greenhouse Gas Protocol
Commonwealth	National Greenhouse and Energy Reporting Act 2007 Clean Energy Legislation (Carbon Tax Repeal) Act 2014
State (NSW)	NSW Net Zero Plan Stage 1: 2020 – 2030 NSW Climate Change Policy Framework

15.4.2 Impacts to GHG during construction

The overall greenhouse gas emissions resulting from the construction of the Proposal have been detailed in Table 15.9. The table displays the Scope 1, Scope 2, and Scope 3 emissions for each of the sources during construction, as well as the overall emissions of construction.

Table 15.9: Construction Emissions

Emissions Source	Quantity	Energy Consumption	Scope 1 Emissions (t CO_2e)	Scope 2 Emissions (t CO_2e)	Scope 3 Emissions (t CO_2e)	Total Emissions (t CO_2e)
Site Vehicles	49 kL	1,899 GJ	134	-	6	140
Construction Plant and Equipment & Generators	1,145 kL	44,202 GJ	3,103	-	142	3,245
Construction Grid Energy	600,000 kWh	2,158 GJ	-	486	54	540
Construction Materials (embedded emissions)	38,300 t	NA	-	-	10,196	10,196
Construction Material transport	Sea – 16,962,000 t.km Land – 1,532,000 t.km	NA	-	-	313	313
Construction Waste and Earth Transport	Land – 619,405 t.km	NA	-	-	29	29
Total	**-**	**48,259 GJ**	**3,222**	**486**	**10,740**	**14,463**

Figure 15.6 displays the composition of the construction stage emissions by source. The gas turbine commissioning and operation phase prior to construction completion comprises three quarters of all emissions during construction. Following this are the embedded emissions in construction materials, which comprise just under 20 per cent of the overall construction emissions. Emissions from waste haulage and the usage of vehicles on site are predicted to contribute the least to the overall construction emissions.

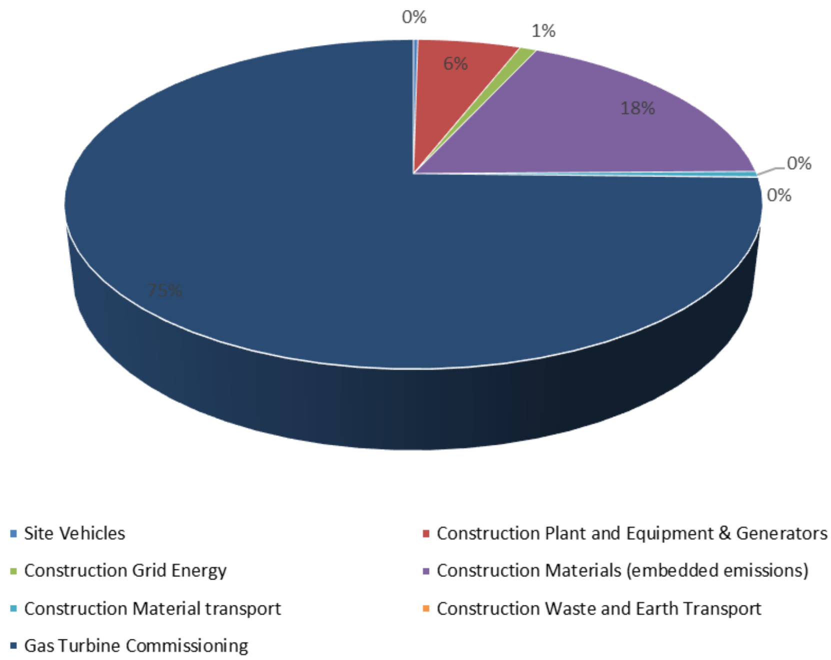


Figure 15.6: Construction GHG Emissions Summary – by source

Table 15.11 and Figure 15.5 provide a breakdown of construction emissions by scope. As shown in the table and figure, Scope 3 emissions (i.e. indirect emissions outside of the direct control of the proponent) make up the vast majority of the estimated construction emissions at 74 per cent. Scope 1 emissions (i.e. direct emissions under the direct control of the proponent) make up just over 20 per cent of the emissions.

Table 15.10: Construction Emissions Summary – by scope

Scope	Emissions (t CO_2e)
Scope 1	3,237
Scope 2	486
Scope 3	10,740
Total	**14,463**

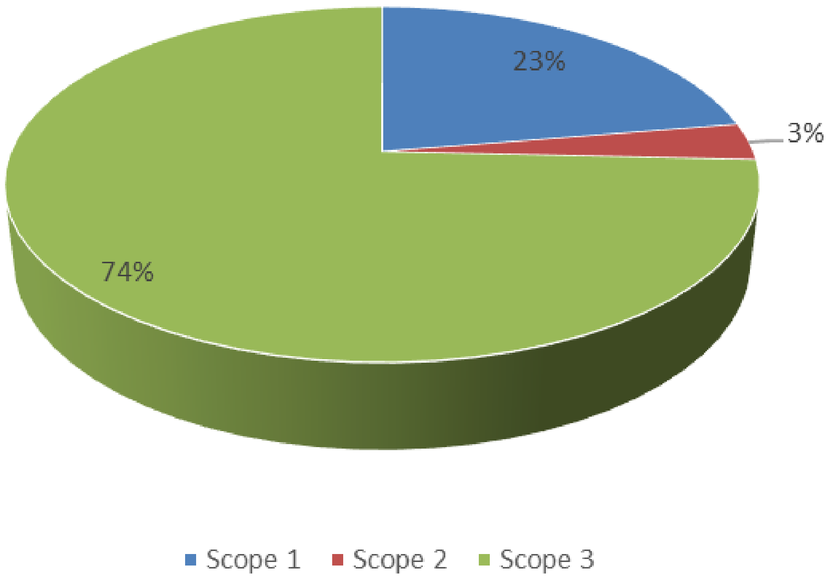


Figure 15.7: Construction Emissions Summary – by scope

15.4.3 Impacts to GHG during operation

The projected annual greenhouse emissions during operation, based on the same operating regime as described in Section 15.3.2, have been summarised in Table 15.11 and Table 15.12. Additionally, the total annual emissions for the operation of the Proposal, divided into Scope 1, Scope 2 and Scope 3 have also been detailed in the tables.

The estimated fuel consumption and emissions has been determined assuming selection of the largest F Class gas turbine being considered for the Proposal and assuming both turbines will be operated concurrently at 100 per cent load with a 10 per cent capacity factor (876 hours) on natural gas and a two per cent capacity factor (175 hours) on diesel fuel each year. These capacity factors are considered conservative for the purposes of environmental assessment. It is expected that likely operation of the Proposal would result in a total capacity factor of two per cent in any given year and some of this time at reduced load.

Year one estimates assume six months of operation only on diesel fuel during commissioning, at a capacity factor equalling 100 hours and then a further six months of operation on gas and diesel at the applicable capacity factors.

Table 15.11: Year 1 Operation emissions

Emissions Source	Estimated Fuel Quantity	Energy Consumption	Scope 1 Emissions (t CO_2e)	Scope 2 Emissions (t CO_2e)	Scope 3 Emissions (t CO_2e)	Total Emissions (t CO_2e)
Diesel Consumption during Gas Turbine Commissioning and prior to construction completion	14,925 kL	576,105 GJ	40,443	-	2,074	42,517
Natural Gas Combustion in Gas Turbine	81,337,415 m^3	3,196,561 GJ	164,719	-	44,752	209,471

Emissions Source	Estimated Fuel Quantity	Energy Consumption	Scope 1 Emissions ($t\ CO_2e$)	Scope 2 Emissions ($t\ CO_2e$)	Scope 3 Emissions ($t\ CO_2e$)	Total Emissions ($t\ CO_2e$)
Diesel Combustion in Gas Turbine	14,171 kL	546,976 GJ	38,398	-	1,969	40,367
Diesel Combustion in Generator	10 kL	371 GJ	26	-	1	27
Grid Energy Usage	578,000 kWh	2,079 GJ	-	468	52	520
Plant Input Haulage	1,034,337 t.km truck	NA	-	-	77	77
Plant Waste Haulage	214 t.km truck	NA	-	-	Negligible	Negligible
Total (Year 1)	-	**4,366,115 GJ**	**243,585**	**468**	**48,925**	**292,978**

Table 15.12: Annual Operation Emissions (Years 2-30)

Emissions Source	Estimated Fuel Quantity	Energy Consumption	Scope 1 Emissions ($t\ CO_2e$)	Scope 2 Emissions ($t\ CO_2e$)	Scope 3 Emissions ($t\ CO_2e$)	Total Emissions ($t\ CO_2e$)
Natural Gas Combustion in Gas Turbine	162,674,830 m^3	6,393,121 GJ	329,438	-	89,504	418,941
Diesel Combustion in Gas Turbine	28,341 kL	1,093,952 GJ	76,795	-	3,938	80,734
Diesel Combustion in Generator	10 kL	371 GJ	26	-	1	27
Grid Energy Usage	578,000 kWh	2,079 GJ	-	468	52	520
Plant Input Haulage	1,034,337 tonne-kilometre truck	NA	-	-	77	77
Plant Waste Haulage	214 t.km truck	NA	-	-	Negligible	Negligible
Total	-	**7,489,523 GJ**	**406,259**	**468**	**93,572**	**500,299**

Figure 15.8 displays the annual operational emissions divided by the source. As expected, the two largest contributors of emissions were the combustion of natural gas and diesel in the turbines. Emissions from the other sources contributed a smaller portion of annual operation emissions.

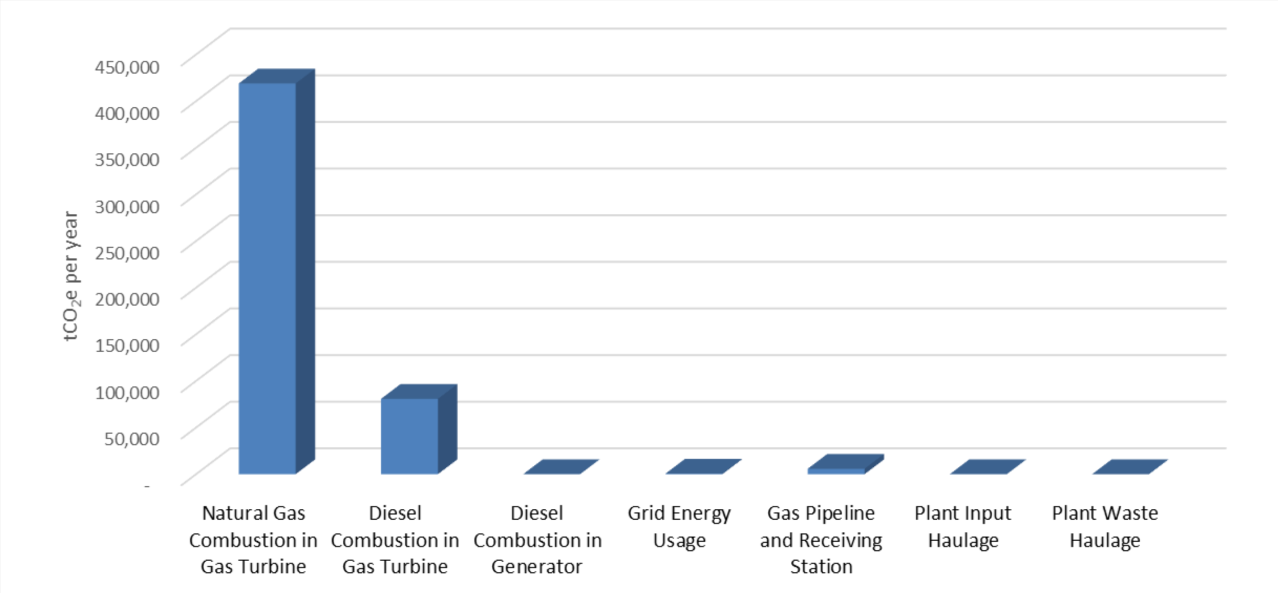


Figure 15.8: Annual Operational Emissions Summary – by source

Table 15.13 and Figure 15.9 provide a breakdown of operational emissions by Scope. Scope 1 emissions comprise the major proportion of emissions, followed by Scope 3 emissions. Scope 2 emissions make up a smaller portion of the emissions.

Table 15.13: Annual Operational Emissions Summary – by scope

Scope	Annual Emissions – Year 1 (t CO2e)	Annual Emissions – Years 2-30 (t CO2e)	Lifetime Emissions – 30 Years (t CO2e)
Scope 1	243,585	406,259	12,025,094
Scope 2	468	468	14,045
Scope 3	48,925	93,572	2,762,514
Total Emissions (all Scopes)	**292,978**	**500,299**	**14,801,653**

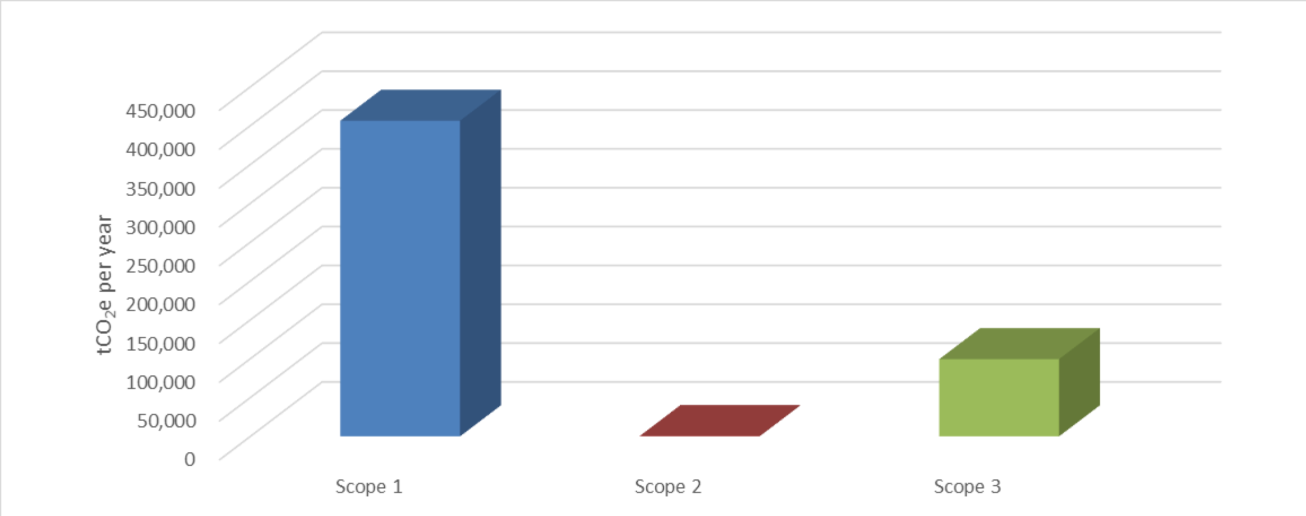


Figure 15.9: Annual Operational Emissions Summary – by scope

Assessment summary – greenhouse gas

The greenhouse gas assessment has been conducted in accordance with National Greenhouse Accounts guidance and associated factors to satisfy the SEAR's. The GHG emissions were estimated for construction and operational phases of the Proposal, and the operational phase GHG emissions compared to the overall energy output of the Proposal.

Overall, Table 15.14 shows the calculated GHG emissions for the life of the Proposal. The construction phase emissions have been calculated as 56,979 t CO_2e. The operational phase emissions have been calculated as 14,463 t CO_2e per annum. Taking into account the annual energy output of the Proposal, the Proposal would have an emission intensity of 0.52 t CO_2e/MWh (Scope 1 + 2). Taking into account that the assessment was conservative, over the 30-year life of the Proposal, the operational GHG emissions are expected to be 14,816,116 tonnes of CO_2 equivalent (Scopes 1 + 2 + 3).

Table 15.14: Proposal Emissions Summary (Scopes 1 + 2 + 3)

	Scope 1 emissions (t CO2e)	Scope 2 emissions (t CO2e)	Scope 3 emissions (t CO2e)	Total emissions (t CO2e)
Construction	3,237	486	10,740	14,463
Annual Operation (Year 1)	243,585	468	48,925	292,978
Annual Operation (Years 2-30)	406,259	468	93,572	500,299
Total (Construction + 30 years Operation)	**12,028,331**	**14,531**	**2,773,254**	**14,816,116**

The projected contribution that it would provide to the total emissions of New South Wales and Australia (based on the latest dataset – 2018) is detailed below:

- New South Wales 131,684 kt CO_2e/y, or 0.4 per cent
- Australia 537,446 kt CO_2e/y, or 0.09 per cent.

- As per Table 15.5, the Proposal will have a projected annual net output of up to 778,405 MWh to the NEM. When compared to the annual operational Scope 1 and 2 greenhouse gas emissions of 406,727 t CO_2e, the Proposal is expected to have an emission intensity of 0.52 tCO_2e/MWh. As displayed in Table 15.15, in comparison with reported emission intensities in the most recent *NGER Electricity Sector Emissions and Generation data* (2018-2019), the Proposal will have one of the lowest emission intensity of all Open Cycle Gas Turbine power stations connected to the NEM in Australia.
- Compared to some of the existing Open Cycle Gas Turbine power stations connected to the NEM, the use of the latest technology F-Class gas turbine design, as proposed for this Proposal, utilises improved turbine blading designs and allows the turbines to operate with higher compression pressure ratios, amongst other design features. These factors contribute somewhat to a decreased gas turbine heat rate and subsequently an increased turbine efficiency and improved emissions intensity.

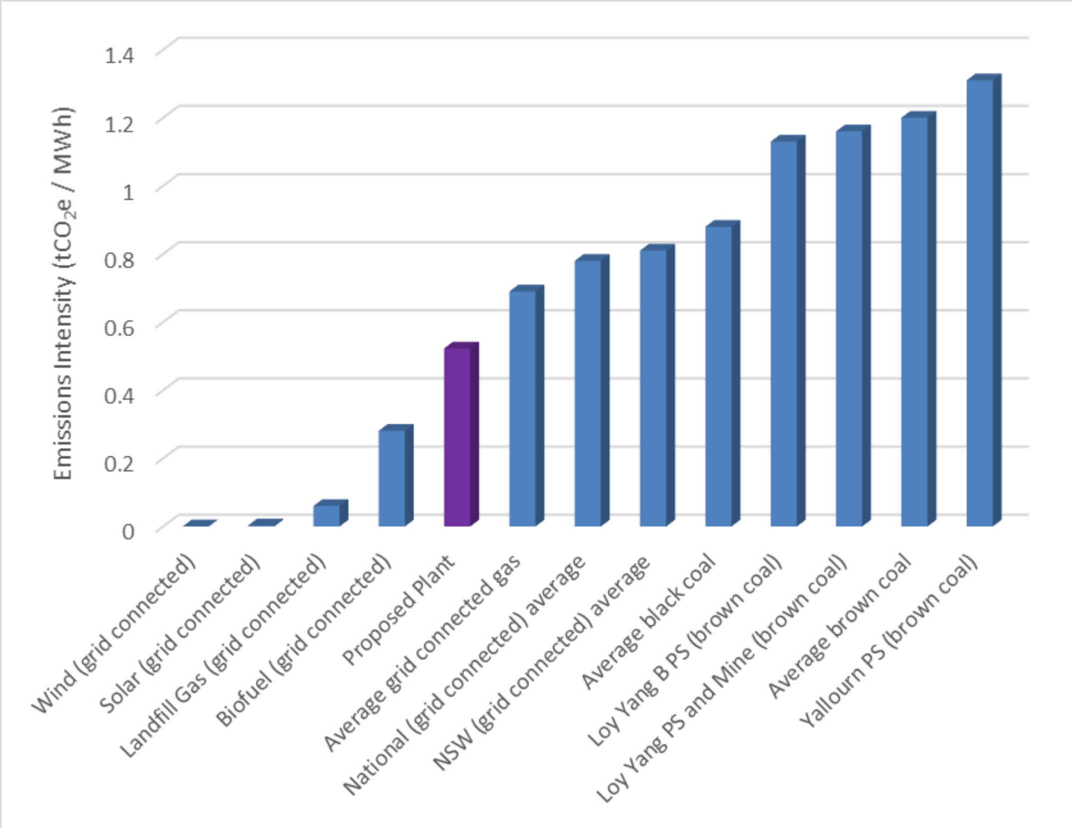
Table 15.15: Comparison of the Proposal emission intensity to the emission intensities of other Open Cycle Gas Turbine Power Stations[1]

Plant Name	Year of Commission	Turbine Class	Nominal Capacity (MW)	Total Emissions (t CO_2e), Scope 1 + 2	Energy Produced (MWh)	Emission Intensity (t CO_2e/MWh)
Oakey Power Station, Qld	1999	E-Class	332	13,838	17,126	0.69
Laverton North Power Station, Vic	2006	E-Class	320	69,192	107,262	0.61
Colongra Power Station, NSW	2009	E-Class	668	22,502	28,864	0.57
Mortlake Power Station, Vic	2012	F-Class	566	683,530	1,215,527	0.56
Bairnsdale Power Station, Vic	2001	Aero-derivative	92	105,093	194,936	0.53
Proposal[2]	**2023**	**F-Class**	**376(3)**	**406,727**	**778,405**	**0.52**

Notes:

1. Total Emissions, Energy Production and Emission Intensities for other plants have been derived from the 2018-2019 NGER Electricity Sector Emissions and Generation Data
2. Parameters for the Proposal are as calculated in this review as if it had been operating in the 2018-19 year. Emission intensities of existing plants would have been impacted by any operations at part-load and by performance degradation since those plants were new.
3. Based on operation on natural gas

Figure 15.10 displays the emission intensity in comparison to other grid connected renewable and fossil fuelled power stations in Australia. As shown, the Proposal is projected to have a lower emission intensity than the average for all other grid connected fossil fuel powered power stations, including the average for other natural gas power stations (which includes combined cycle plants).



Emission Intensities for other plants have been derived from the 2018-2019 NGER Electricity Sector Emissions and Generation Data.

Figure 15.10: Comparison of the emission intensity of the Proposal to other power sources

15.5 Mitigation measures

Potential air quality and GHG impacts would be mitigated through implementation of measures outlined in Table 15.16.

Sulphur content in natural gas used by the Proposal is expected to be significantly less than the maximum total allowed in natural gas as specified in Australian Standard *AS 4564:2011 – Specification for general purpose natural gas* and also as referenced by the Australian Energy Market Operator (AEMO) in their Gas Quality Guidelines. The sulphur limit for diesel fuel used by the Proposal will also be below the maximum allowed for Automotive Diesel (10 mg/kg).

Table 15.16: Air quality mitigation measures

Reference	Mitigation Measure	Timing
AQ1	A dust management plan will be developed by the nominated construction contractor and included with the construction environmental management plan for the project.	Construction
AQ2	Construction plant and equipment will be well maintained and regularly serviced so that vehicular emissions remain within relevant air quality guidelines and standards.	Construction
AQ3	Gas turbine plants will adopt and utilise the best available/most appropriate technology for controlling emissions, such as Dry Low Emissions (DLE) burners on the gas turbines for use when operating on natural gas fuel, and using Water Injection (WI) control technology in the gas turbine burners when burning diesel fuel.	Operation

16. Noise and vibration

The Noise and Vibration Impact Assessment (NVIA) (Appendix L) has been prepared in accordance with the SEARs, to assess the Proposal's likely noise and vibration impacts during construction and operation. This chapter of the EIS provides a summary of the assessment methodology, the findings and recommendations from the assessment, and discussion of the measures that would be implemented to mitigate noise generated by the Proposal. The detailed report can be viewed at Appendix L.

16.1 Assessment methodology

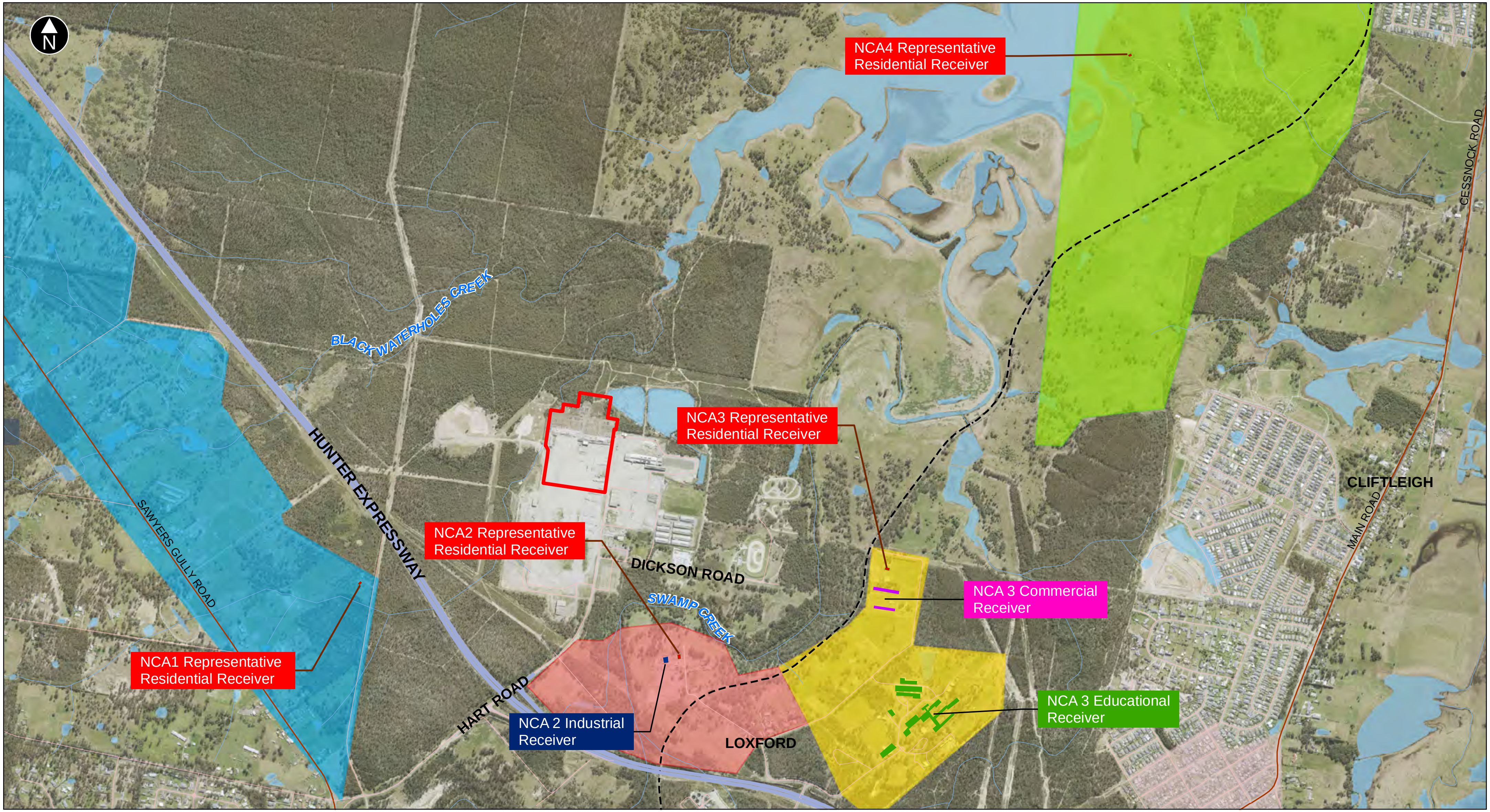
The NSW EPA sets guidance and criteria for major development proposals in terms of the different types of noise and vibration likely to be generated during construction and operation of a proposal. These guidelines and criteria form the basis of impact assessments, based on an understanding of existing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

16.1.1 Noise Catchment Areas

Based upon the land use of the areas surrounding the Proposal Site, four Noise Catchment Areas (NCAs) have been established to assess potential noise impacts. Table 16.1 below details each NCA, and the extent of the NCAs are displayed in Figure 16.1.

Table 16.1: Noise catchment area summary

Noise Catchment Area	Location	Approximate Distance of Nearest Sensitive Receiver from Centrepoint of Power Island	Predominate Land Uses	Predominate Background Noise Feature
NCA 1	Sawyers Gully	1.2 km	Rural Residential, Farmland	Hunter Expressway, Environmental Noise
NCA 2	Western Loxford	1.2 km	Rural Residential, Light Industry	Hunter Expressway, Environmental Noise, Industrial Noise
NCA 3	Eastern Loxford	1.6 km	Rural Residential, Educational	Environmental Noise, Local Road Noise
NCA 4	Gillieston North	3.2km	Farmland	Environmental Noise



Proposal site
Motorway
Main roads
Roads
Railway

Noise Catchment Areas
NCA 1
NCA 2
NCA 3
NCA 4

Receivers
NCA 3 Commercial Receiver
NCA 3 Educational Receiver
NCA 2 Industrial Receiver
Representative Residential Receiver

0 0.5 1 km

1:25,000 at A4

GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

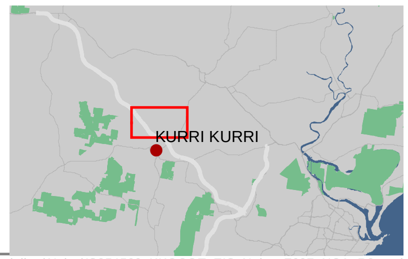


Figure 16-1 Noise Catchment Areas

16.1.2 Background Noise Levels

Background noise monitoring was performed during a period between December 2020 and January 2021. A monitoring location was selected to represent each of the NCAs. A summary of the monitored background noise levels is provided in Table 16.2.

Table 16.2: Background Noise Levels

Monitor ID	NCA	Monitoring Location	Monitoring Duration	Measurement	Measured Noise Level – dB(A)		
					Day (7:00 am to 6:00 pm)	Evening (6:00 pm to 10:00 pm)	Night (10:00 pm to 7:00 am)
NM1	NCA 1	103 Bishops Bridge Rd, Sawyers Gully	15 Jan – 23 Jan 2021(1)	L_{Aeq} (equivalent noise level)	56	58	53
				RBL (Background L_{A90})	47	48	44
NM2	NCA 2	10 Dawes Ave, Loxford	30 Nov – 14 Dec 2020	L_{Aeq} (equivalent noise level)	62	57	55
				RBL (Background L_{A90})	55	50	48
NM3	NCA 3	8 Bowditch Ave, Loxford	30 Nov – 14 Dec 2020, 15 Jan – 23 Jan 2021(1)	L_{Aeq} (equivalent noise level)	58	55	52
				RBL (Background L_{A90})	52	44	46
NM4	NCA 4	464 Cessnock Rd, Gillieston Heights	30 Nov – 14 Dec 2020	L_{Aeq} (equivalent noise level)	56	51	51
				RBL (Background L_{A90})	48	48	45

Note

1. Monitoring was originally performed on the 30 Nov – 14 Dec, however the device was vandalised, requiring a second round of monitoring.

16.1.3 Assessment criteria

Construction noise management levels

The Interim Construction Noise Guideline (ICNG) (Department of Environment and Climate Change [DECC], 2009) provides guidance for assessing noise from construction activities in NSW. It establishes noise management levels (NMLs) for recommended standard construction hours and for outside of the recommended standard hours. Construction is considered to have the potential to cause a noise impact if the predicted noise exceeds the applicable noise management level. Table 16.3 lists ICNG guidance for establishing construction NMLs at residential receivers.

Table 16.3: ICNG guidance for establishing construction NMLs at residential receivers

Time of day	Management level $L_{Aeq(15min)}$	How to apply
Recommended standard construction hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected: Rating Background Level (RBL) + 10 dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected: 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account times identified by the community when they are less sensitive to noise, such as: ▪ Before and after school for works near schools ▪ Mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours - All other times including public holidays	Noise affected: RBL + 5 dB(A)	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to avoid exceeding the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Considering the adopted RBLs presented in Table 16.2, the NMLs for the identified surrounding residential receivers are presented in Table 16.4.

Table 16.4: Construction noise management levels (residential receivers)

NCA	NML $L_{eq\ 15\ min}$ dB(A)			
	Day (during standard hours) 7am – 6pm Weekdays, 8am – 1pm Saturdays	Day (outside standard hours) 7am – 6pm Outside of Standard Hours	Evening 6:00pm-10:00pm	Night 10:00pm-7:00am
NCA 1	57	52	52(1)	49
NCA 2	65	60	55	53
NCA 3	62	57	49	49(2)
NCA 4	58	53	53	50

Notes:

1. Criteria reduced so Evening criteria is not higher than Day Outside recommended standard hours criteria.
2. Criteria reduced so Night criteria is not higher than Evening criteria.

The ICNG also provides construction NMLs for non-residential land uses. These are presented in Table 16.5.

Table 16.5: ICNG NMLs for non-residential receivers

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

Construction traffic noise

Road traffic noise impacts due to the construction (and operation) of the Proposal were assessed against the following guidance from the application notes of the EPA's NSW Road Noise Policy (RNP) (2011):

"…for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion."

Sleep disturbance

For premises where night construction (and operations) occur, the potential for noise levels to lead to sleep disturbance should be considered. Section 4.3 of the ICNG discusses the method for assessing and managing sleep disturbance. Where noise levels from a construction (or industrial) source at a residential receptor at night exceeds the following, a maximum noise level event assessment should be undertaken:

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

Based on this guidance, Table 16.6 presents sleep disturbance screening criteria for the noise catchment areas surrounding the Proposal.

Table 16.6: Sleep disturbance criteria

Noise Catchment Area	$L_{eq\ 15\ min}$ dB(A)	L_{AFMax} dB(A)
NCA 1	49	54
NCA 2	53	58
NCA 3	51	56
NCA 4	50	55

16.1.4 Operational noise

The NPI recommends that the more stringent values between intrusiveness and amenity noise level criteria be applied for an operational noise assessment. Table 16.7 presents the operational noise criteria adopted for the various NCAs related to the Proposal and this assessment.

Table 16.7: Proposal operational noise criteria

Receiver type	Time of day	Recommended L_{Aeq} Noise Level dB(A)
NCA 1	Day (7:00 am to 6:00 pm)	52
	Evening (6:00 pm to 10:00 pm)	48
	Night (10:00 pm to 7:00 am)	43
NCA 2	Day (7:00 am to 6:00 pm)	58
	Evening (6:00 pm to 10:00 pm)	48
	Night (10:00 pm to 7:00 am)	43
NCA 3	Day (7:00 am to 6:00 pm)	57
	Evening (6:00 pm to 10:00 pm)	48
	Night (10:00 pm to 7:00 am)	43
NCA 4	Day (7:00 am to 6:00 pm)	53
	Evening (6:00 pm to 10:00 pm)	48
	Night (10:00 pm to 7:00 am)	43

16.1.5 Vibration guidelines

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

16.1.6 Construction noise emissions

Sound power levels were estimated for certain main phases of construction for the Proposal. Sound power levels for each construction phase were determined by:

- Developing an inventory of the major noise producing equipment (construction machinery) and the estimated numbers of equipment likely to be operating at a given time based on the works taking place

- Estimating the sound power levels of each piece of equipment using sound power levels presented in national and international standards and guidelines, as well as from a Jacobs measurement database.

The assessment approach assumed all plant and equipment for each activity was operated concurrently while positioned at the location closest to each individual receiver. For this assessment, it has been assumed that construction works would take place during standard construction hours, although with the potential for some out of hours day works occurring.

The Proposal would result in additional traffic movements to the Proposal Site, which would result in additional vehicle-related noise emissions being generated. During construction, the predicted peak additional traffic flows were estimated as follows (assuming one vehicle entering then leaving the site is counted as two vehicle movements, one in and one out):

- Approximately 400 additional light vehicle movements per day, with morning and afternoon peaks (200 inbound trips during the morning peak hour and 200 outbound trips during the afternoon peak hour)
- Approximately 120 additional heavy vehicle movements per day (60 inbound trips and 60 outbound trips)
- Approximately two additional oversize overmass heavy vehicle movements during the night (one inbound trip and one outbound trip).

16.1.7 Operational noise emissions

The operational noise was divided into two sources, namely the power islands (i.e. the gas turbines, generator and exhaust stack and supporting equipment), and the balance of plant (i.e. diesel unloading station, water pumps and the demineralisation plant). Table 16.8 details the estimated noise levels of the main power island components based on a representative 'typical' offering from the major equipment suppliers, including noise reductions that would be achieved by attenuation designed and built into the Proposal. The table also displays the attenuated component levels, which were used in the noise modelling and impact assessment. Table 16.9 displays the indicative noise levels from the balance of plant.

Table 16.8: Power island sound power levels

Noise source	Unattenuated sound power level			Attenuation applied (dB)	Attenuated sound poer level		
	dB	dB(A)	dB(C)		dB	dB(A)	dB(C)
Exhaust Stack/Opening	135	109	132	12	123	97	120
Exhaust Diffuser	125	112	122	14	111	98	108
Gas Turbine Housing	122	104	123	6	116	98	117
Gas Turbine Air Inlet	117	107	116	12	105	95	104
Gas Turbine Generator Enclosure	121	102	119	5	116	97	114
Generator Step-up Transformers[1]	116	104	115	5	111	99	110
Generator Fin Fan Cooler	116	100	112	3	113	97	109
Hydraulic Skid	99	96	99	Nil	99	96	99
Liquid Fuel Module	100	96	99	Nil	100	96	99
Fuel Gas Systems	99	96	98	Nil	99	96	98

Notes:

1. Transformers were indicated as a candidate for the tonality noise level correction as per Fact Sheet C of the NPI. However, suppliers have indicated that the transformers will be attenuated for tonal noise, hence the attenuated transformers were predicted to not pose a tonal noise risk and the tonality correction was not applied.

Table 16.9: Balance of Plant Sound Power Levels

Noise source	Overall sound power level		
	dB	dB(A)	dB(C)
Water Tank Pumps	95	93	95
Liquid Fuel (diesel) Pump Station	88	85	88
Demineralisation Plant	88	85	88

The operation of the Proposal would require traffic movements to deliver personnel, fuel and equipment to the Proposal Site. As with during construction, this would result in additional vehicle-related noise emissions generated from the Proposal Site. During operation, two events would result in higher traffic flows than normal conditions, namely diesel fuel replacement events (considered an infrequent event only required when the plant is operated on diesel or when the diesel fuel needs to be replaced due to lack of use) and gas turbine major overhaul events (occurring for approximately six days a week for a six-week period, once every 10 years).

Noise from the operation of the Proposal was modelled using the SoundPLAN 8.0 acoustic modelling software. Within the noise modelling software, the CONCAWE noise propagation calculation was applied for dB(A) noise calculations. The CONCAWE calculation was selected due to its reliability in assessing industrial noise impacts.

16.2 Impact assessment

16.2.1 Construction

The estimated noise levels at the nearest receivers were predicted from the anticipated noise levels generated during certain construction phases of the Proposal. Table 16.10 presents the predicted noise impact at each representative residential receiver during each construction phase while Table 16.11 presents the predicted noise impact at each non-residential receiver during each construction phase.

The assessment approach assumed all plant and equipment for each activity was operated concurrently while positioned at the location closest to each individual receiver. This was considered to be a conservative approach and while this may provide for the determination of conservative noise levels, actual construction noise levels should be lower than predicted in this assessment.

As Table 16.10 shows, noise levels are not predicted to exceed the standard hours or out of hours daytime NMLs at any residential receivers in each NCA during any construction phase. As listed in Table 16.11, construction noise levels are not predicted to exceed NMLs at any non-residential receivers in each of the NCAs.

The construction phases which were predicted to result in the highest noise levels at the nearest sensitive receiver are the initial site earthworks, and the surfacing works (i.e. Phases 1 and 8). These works would result in noise levels of 51 dB(A) and 49 dB(A) at the nearest residential receiver, respectively.

Noise contour maps for each of the assessed construction stages are displayed in Appendix L.

Table 16.10: Noise impacts from construction works at residential receivers

Construction phase	NCA 1			NCA 2			NCA 3			NCA 4		
	Highest predicted noise level at NCA 1 representative residential receiver (dB(A))	Compliant with noise criteria?		Highest predicted noise level at NCA 2 representative residential receiver (dB(A))	Compliant with noise criteria?		Highest predicted noise level at NCA 3 representative residential receiver (dB(A))	Compliant with noise criteria?		Highest predicted noise level at NCA 4 representative residential receiver (dB(A))	Compliant with noise criteria?	
		Standard hours – 57 dB(A)	Out of hours, daytime – 52 dB(A)		Standard hours – 65 dB(A)	Out of hours, daytime – 60 dB(A)		Standard hours – 62 dB(A)	Out of hours, daytime – 57 dB(A)		Standard hours – 58 dB(A)	Out of hours, daytime – 53 dB(A)
1	47	Yes	Yes	51	Yes	Yes	45	Yes	Yes	32	Yes	Yes
2	42	Yes	Yes	45	Yes	Yes	40	Yes	Yes	<30	Yes	Yes
3	45	Yes	Yes	48	Yes	Yes	43	Yes	Yes	31	Yes	Yes
4	36	Yes	Yes	40	Yes	Yes	35	Yes	Yes	<30	Yes	Yes
5	30	Yes	Yes	34	Yes	Yes	30	Yes	Yes	<30	Yes	Yes
6	31	Yes	Yes	35	Yes	Yes	<30	Yes	Yes	<30	Yes	Yes
7	33	Yes	Yes	36	Yes	Yes	31	Yes	Yes	<30	Yes	Yes
8	45	Yes	Yes	49	Yes	Yes	43	Yes	Yes	30	Yes	Yes

Table 16.11: Noise impacts from construction works at non-residential receivers

Phase	NCA 2[1]		NCA 3[1]			
	Highest predicted noise level at NCA 2 industrial receiver (dB(A))	Compliant with noise criteria? Industrial – 75 dB(A)	Highest predicted noise level at NCA 3 commercial receiver (dB(A))	Compliant with noise criteria? Commercial – 70 dB(A)	Highest predicted noise level at NCA 3 educational receiver (dB(A))	Compliant with noise criteria? Educational – 55 dB(A)
1	51	Yes	45	Yes	42	Yes
2	45	Yes	40	Yes	38	Yes
3	48	Yes	43	Yes	40	Yes
4	40	Yes	35	Yes	32	Yes
5	34	Yes	30	Yes	27	Yes
6	34	Yes	29	Yes	26	Yes
7	36	Yes	31	Yes	29	Yes
8	49	Yes	43	Yes	40	Yes

Note:

1. There were no non-residential receivers identified in NCA 1 and NCA 4

Existing traffic volumes on the Hunter Expressway were obtained from the nearest Transport for NSW (TfNSW) permanent count stations located 3.5 km north of the Expressway exit to the Proposal Site. During construction of the Proposal, estimated daily construction traffic is expected to comprise approximately 200 light vehicle movements in the morning peak hour and 200 movements in the afternoon peak hour, and 120 heavy vehicle movements spread across standard hours. Large items would be brought to the Proposal Site using oversize vehicles, which would most likely be restricted to night time or off-peak travel. Up to two oversize overmass vehicle movements during the night would be expected during the infrequent occasions when such deliveries take place.

Using the Construction Noise Estimator, it was determined that noise from existing road traffic plus the additional construction traffic would be 63 dB(A) during the day and 61.2 dB(A) during the night, which is above the 60 dB(A) $L_{Aeq,15hr}$ noise criteria and 55 dB(A) $L_{Aeq,9hr}$ noise criteria at the nearest sensitive receiver (75 m away from the road alignment). However, the additional construction traffic associated with the Proposal would contribute only 0.2 dB(A) to the overall traffic noise level during the day and would contribute less than 0.1 dB(A) to the traffic noise level during the night. Therefore, the 2 dB(A) traffic noise increase criterion would not be exceeded, and it was concluded that the noise generated by the additional traffic associated with the Proposal's construction would not present a noise impact issue.

Construction is not predicted to take place during the night, and as such construction activities associated with the Proposal would not result in sleep disturbance impacts.

16.2.2 Operational Noise

The Proposal's predicted noise impacts on residential receivers during operation are detailed in Table 16.12, while impacts on non-residential receivers during operation are detailed in Table 16.13. The 'standard' and 'noise-enhancing' meteorological conditions were adopted for the assessment, and the Proposal has been assumed to potentially operate at any time of day or night.

The noise model predicted that operational noise levels would be compliant at all receivers at all times. The receiver with the highest noise impact was the nearest sensitive receiver in NCA 2. Under standard conditions noise levels were predicted to be 39 dB(A), while noise levels under noise-enhancing conditions were predicted to be 43 dB(A). Generally, noise-enhancing conditions increase noise levels at receivers by approximately 5 dB(A).

The noise model results also show that operational noise emissions would be closest to the noise criterion during the night period. Operations at night will be less likely to occur, and any night time operation would likely be of shorter duration. Therefore, the risk of the Proposal's operation approaching or exceeding the night time noise criterion is minimised, through the reduced likelihood and shorter duration of night time operations, compared with the likely frequency and duration of daytime or evening operations.

Noise contours displaying the spatial distribution of noise from operation of the Proposal are displayed in Figure 16.2 and Figure 16.3.

Table 16.12: Operational noise impact at the nearest residential receivers

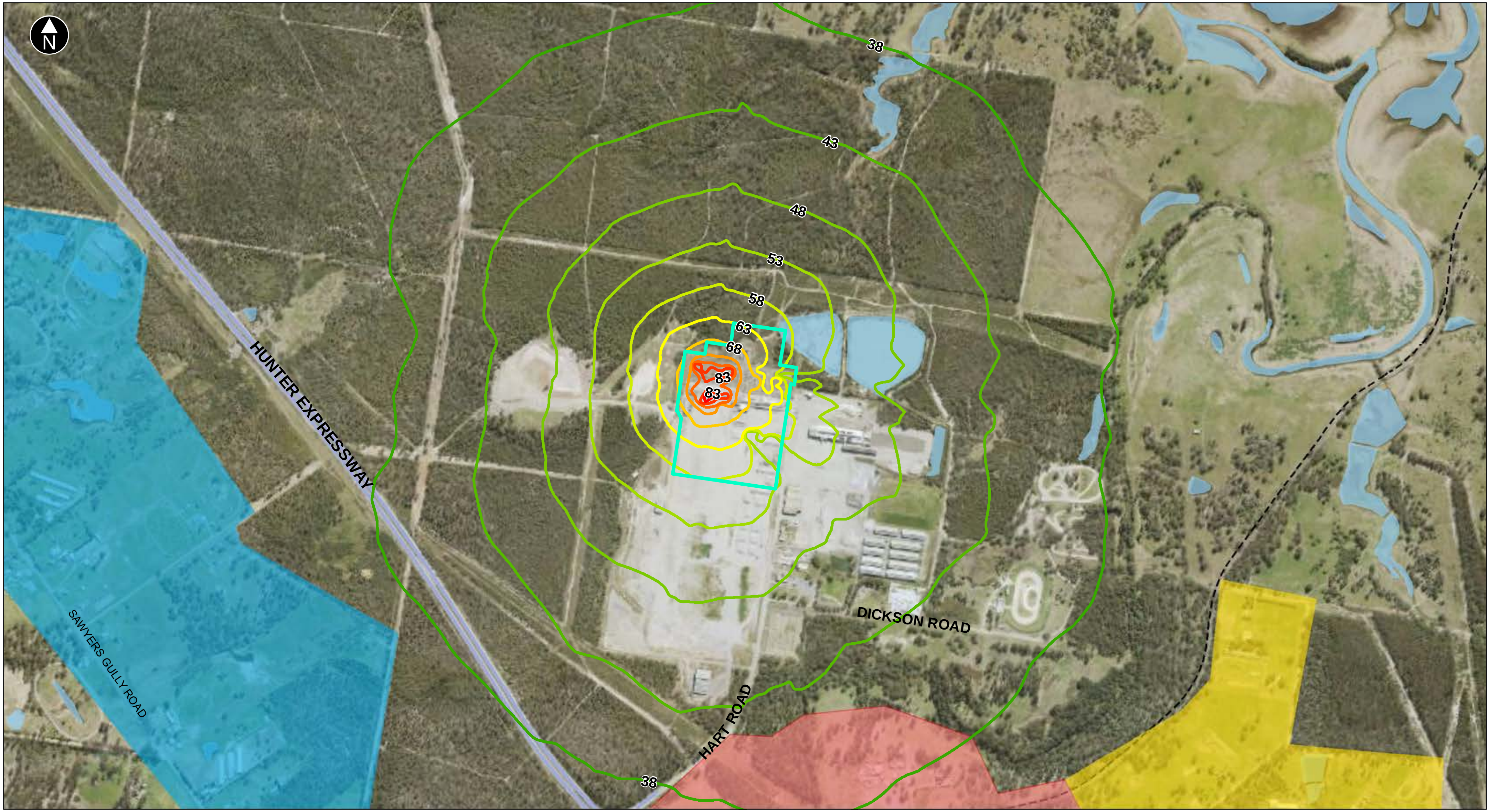
Noise level at nearest residential receiver in Noise Catchment Area	Highest predicted noise level at residential receiver		Noise criteria	Compliant with noise criteria?	
	Standard conditions	Noise-enhancing conditions		Standard conditions	Noise-enhancing conditions
NCA 1 Representative residential receiver	36 dB(A)[1]	41 dB(A)[1]	Day – 52 dB(A)	Yes	Yes
			Evening – 48 dB(A)	Yes	Yes
			Night – 43 dB(A)	Yes	Yes
			Sleep disturbance – 54 dB(A)	Yes	Yes
NCA 2 Representative residential receiver	39 dB(A)[1]	43 dB(A)[1]	Day – 58 dB(A)	Yes	Yes
			Evening – 48 dB(A)	Yes	Yes
			Night – 43 dB(A)	Yes	Yes
			Sleep disturbance – 58 dB(A)	Yes	Yes
NCA 3 Representative residential receiver	34 dB(A)	39 dB(A)	Day – 57 dB(A)	Yes	Yes
			Evening – 48 dB(A)	Yes	Yes
			Night – 43 dB(A)	Yes	Yes
			Sleep disturbance – 56 dB(A)	Yes	Yes
NCA 4 Representative residential receiver	<30 dB(A)	<30 dB(A)	Day – 53 dB(A)	Yes	Yes
			Evening – 48 dB(A)	Yes	Yes
			Night – 43 dB(A)	Yes	Yes
			Sleep disturbance – 55 dB(A)	Yes	Yes

Note:

1. A 2 dB positive adjustment for low frequency noise applies to the predicted noise levels as required under the NSW NPI (2017).

Table 16.13: Operational noise impact at the nearest existing non-residential receivers

Non-residential receiver	Highest predicted noise level at non-residential receiver		Noise criteria	Compliant with noise criteria?	
	Standard conditions	Noise-enhancing conditions		Standard conditions	Noise-enhancing conditions
NCA 2 Industrial receiver	39 dB(A)	44 dB(A)	Industrial criteria – 68 dB(A)	Yes	Yes
NCA 3 Commercial receiver	34 dB(A)	39 dB(A)	Commercial criteria – 63 dB(A)	Yes	Yes
NCA 3 Educational receiver	32 dB(A)	37 dB(A)	Educational criteria – 43 dB(A)	Yes	Yes



Proposal site
Motorway
Railway
Waterbodies

Noice catchment areas
NCA 1
NCA 2
NCA 3

Noise Level dB(A)

38	63
43	68
48	73
53	78
58	83
	88

0 0.5 1 km

Representative frequency range: 16 Hz to 8000 Hz

Modelling parameters:
- Calculation at 1.5m above ground
- 20°C temperature and 70% humidity
- Neutral weather conditions (Pasquill Grade D with wind speed of 0 m/s)
- Softground G = 1.0
- Calculation method: Concawe

1:15,000 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs
Metromap (Aerometrex) 2020
NSW Spatial Services

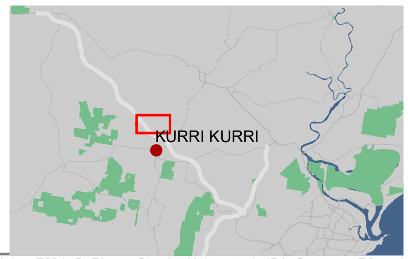


Figure 16-2 Power Station dB(A) Levels under Standard Meteorological Conditions

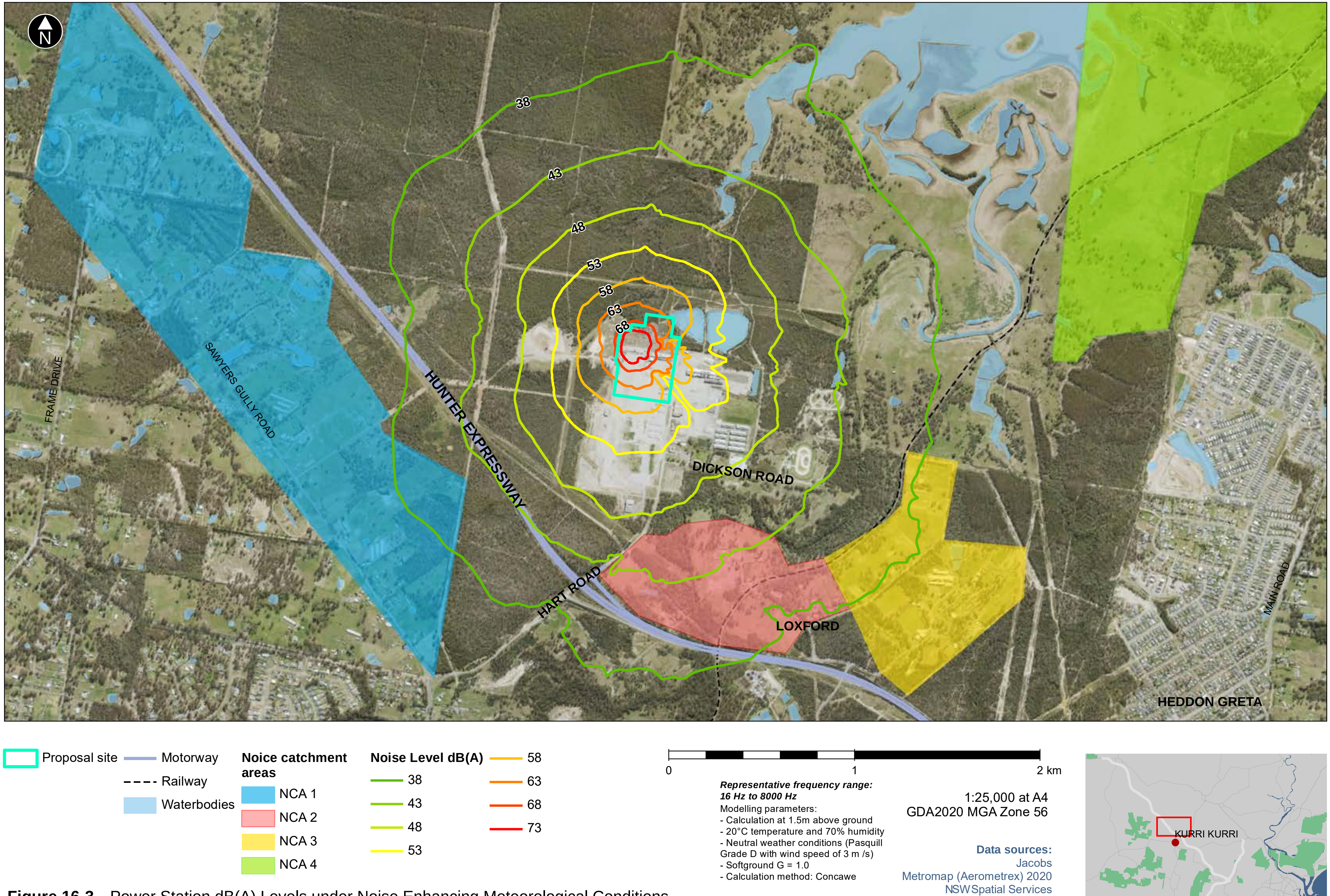


Figure 16-3 Power Station dB(A) Levels under Noise Enhancing Meteorological Conditions

snowyhydro renewable energy Jacobs

Date: 5/03/2021 Path: J:\IE\Projects\04_Eastern\IS354500\22_Spatial\GIS\Directory\Templates\Figures\KurriKurriEIS\Specialists\Noise\IS354500_KKOCGT_EIS_Noise_F026_OpPhase_FClassAttenuated_dBA_Contours_R2.mxd
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Chapter 4 of this EIS discusses the current master planning proposal by ReGrowth Kurri Kurri to rezone and subdivide land in the vicinity of the Proposal Site, for a mixture of land uses including light and heavy industry. When the planned industrial lots adjacent to the Proposal Site are occupied, the occupiers of those lots would experience noise from the Proposal. However, the levels would remain below the operational noise criteria for industrial receivers. The predicted operational noise impact at the Proposal Site boundary is detailed in Table 16.14.

Table 16.14: Operational noise impacts at the Proposal Site boundary

Non-residential receiver	Highest predicted noise level at non-residential receiver		Noise criterion	Compliant with noise criteria?	
	Standard conditions	Noise-enhancing conditions		Standard conditions	Noise-enhancing conditions
Site boundary	61 dB(A)	64 dB(A)	Industrial criterion 68 dB(A)	Yes	Yes

The additional operational traffic noise associated with diesel fuel replacement and gas turbine major overhauls would not lead to any noise impact. No equipment used during the operation of the Proposal has been predicted to produce vibration impacts.

16.2.3 Vibration

A vibratory roller and piling rig, which are considered to be a vibration-generating plant, would be used during construction. With the use of a piling rig and vibratory roller, cosmetic damage impacts may occur up to 25 m away from the works, while human response impacts may occur up to 100 m away from the works. As no vibration receivers are located within these distances, no vibration impacts have been predicted. Additionally, as the nearest medical facility is over three km away from the Proposal Site, no impacts to medical facilities due to construction vibration have been predicted.

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

16.2.4 Potential cumulative impacts

Although the nearest noise sensitive receiver is approximately 1.2 km from the Proposal Site, potential noise impacts at the boundary of the Proposal Site have been assessed as a precautionary measure in consideration of future development of neighbouring properties. The highest predicted noise level along the Proposal Site boundary does not exceed the noise criterion for industrial receivers.

If any adjacent properties were occupied prior to or during construction of the Proposal, some vibration impacts may occur. In this case, mitigation measures are recommended to reduce vibration impacts (refer Section 7.1.2 of Appendix L).

Construction and operation of the gas receival station is subject to a separate third party assessment and approval process. Based on the current construction scheduling, the gas receival station will most likely be constructed towards the end of the Proposal construction phase. Therefore, it is unlikely that the noisiest activities of both projects would coincide. Hence, significant cumulative noise impacts are not expected during construction of the gas receival station.

The Proposal and the gas receival station would operate simultaneously. Completed noise modelling found that the gas receival station would contribute less than 0.1 dB to the noise levels at the boundary of the Proposal Site and hence would not represent a significant cumulative impact.

16.3 Mitigation measures

No residential or non-residential exceedances have been predicted at any of the NCAs surrounding the Proposal, nor have any exceedances of the industrial receiver criteria been predicted. As such, no mitigation measures for noise impacts are considered necessary. However, a number of mitigation measures are suggested in Table 16.15 to assure that construction noise levels remain below the relevant criteria.

Compliance with operational noise criteria can be achieved through the advised level of attenuation detailed in Table 16.8. This level of attenuation can be achieved through the use of attenuation packages, which are provided by the suppliers of the gas turbine equipment and are specifically incorporated into the design of the equipment (i.e. a bespoke design to meet the specific requirements of the Proposal Site, taking into account locations of and distances to nearby sensitive receivers). Attenuation options may include slow fan speeds for cooling systems, improved sound enclosures, improved stack design and sound attenuation walls.

Table 16.15: Mitigation measures

Reference	Mitigation measure	Timing
NV1	A Construction Noise and Vibration Management Plan (CNVMP) will be developed to manage noise during construction. This will include consideration of plant selection, construction hours, plant maintenance, construction traffic and transport, staff awareness, construction staging and monitoring.	Construction
NV2	The acoustic performance of the gas turbine equipment attenuation will be verified and demonstrated through additional noise modelling of the preferred design solution, prior to commencement of construction.	Detailed design
NV3	Noise monitoring of the Proposal post construction will be performed to verify the predicted noise levels at the relevant receivers. These levels will then be used to review and if necessary, improve the equipment and other attenuation requirements and to confirm that the noise attenuation achieves compliance.	Operation

17. Traffic and transport

The purpose of this chapter is to assess the potential traffic and transport impacts from construction and operation of the Proposal. Based on the Traffic and Access assessment report (Appendix M), this chapter addresses the relevant SEARs by outlining the assessment methodology, describing the existing environment with respect to traffic and transport, assessing the construction and operational impacts and recommending mitigation measures.

17.1 Assessment methodology

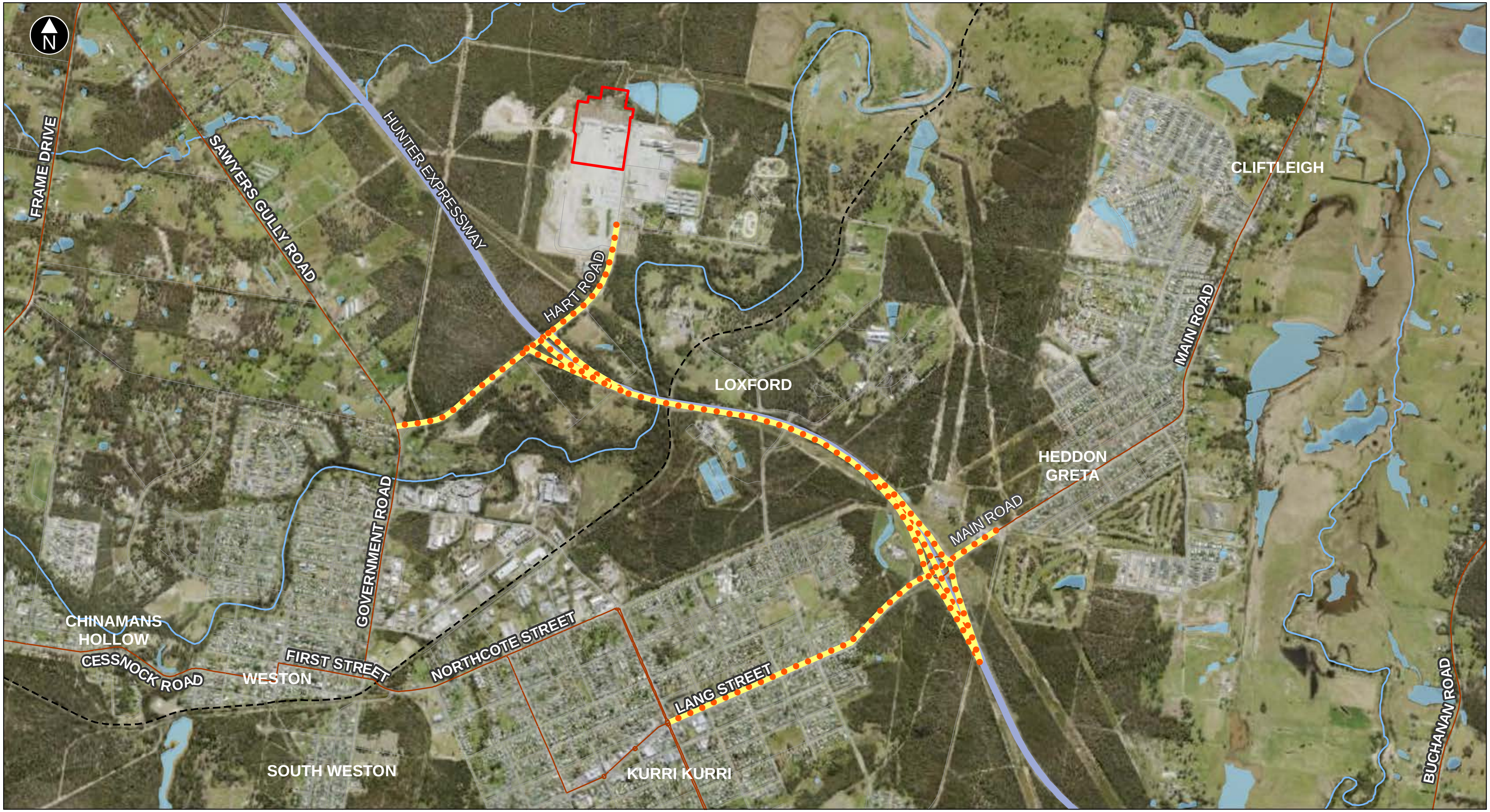
A summary of the methodology used to assess the impact of the Proposal on the transport network is provided in Table 17.1.

Table 17.1: Summary of the traffic and transport assessment approach

Component of transport and traffic assessment	Assessment approach
Impacts on the road network	Desktop analysis of the expected performance of the road network during construction and operation of the Proposal. Given existing traffic volumes and network capacity, and the relatively low volumes of traffic that the Proposal would generate during construction and operation, network and intersection traffic modelling was not considered to be necessary for the Proposal's assessment.
Impacts on parking	Desktop analysis of existing parking provisions compared with parking provisions during construction and operation of the Proposal
Impacts on access	Analysis of existing access provisions compared with access provisions during construction and operation of the Proposal
Impacts on public transport	Analysis of potential impacts on public transport operations during construction and operation of the Proposal
Impacts on pedestrians and cyclists	Analysis of potential impacts on access to and availability of cycleways and footpaths during construction and operation of the Proposal
Impacts on safety	Analysis of expected impacts to road safety for roads forming part of the proposed construction vehicle routes
Impacts of oversize overmass (OSOM) vehicles	Analysis of expected impacts of OSOM vehicles as well as controls required to manage these impacts

17.1.1 Study Area

The study area for the traffic and transport assessment comprised the transport network that provides the likely access routes to be used by construction and operational vehicles associated with the Proposal. This includes the roads between the Proposal Site, the M15 Hunter Expressway, and the nearby town of Kurri Kurri. The study area is shown in Figure 17.1.



Proposal site
Motorway
Waterbodies
Access routes
Main roads
Roads
Railway

0 1 2 km

1:30,000 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs 2020
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 17-1 Study area: Traffic and access

Date: 8/03/2021 Path: J:\IE\Projects\04_Eastern\IS354500\22_Spatial\GIS\Directory\Templates\Figures\KurriKurriEIS\Specialists\Traffic\IS354500_KKOCGT_EIS_Traffic_F003_Traffic&Access_R1.mxd
Created by : AA | QA by : KI

17.2 Existing environment

17.2.1 Existing Road Network

The road network near the Proposal Site includes the M15 Hunter Expressway and Hart Road. The Hunter Expressway is a motorway providing connectivity between the M1 Pacific Motorway at the Newcastle Link Road interchange at Cameron Park and the New England Highway at Lower Belford. Near the Proposal Site, the Hunter Expressway is a four-lane, two-way dual carriageway road with a posted speed limit of 110 kilometres per hour.

Hart Road is accessible from the Hunter Expressway via on and off-ramps to and from the east only. To travel west, an interchange is located at the intersection of the Hunter Expressway and Main Road, approximately 3 km southeast of the Proposal Site allowing westbound traffic to enter, and eastbound traffic to exit the Hunter Expressway. Site observations identified that traffic volumes at the Hart Road interchange are generally low.

Hart Road is a connector road that facilitates access between industrial and recreational land uses at Loxford and the Hunter Expressway as well as to local roads at Weston and Kurri Kurri. Near the Proposal Site, the posted speed limit is 70 kilometres per hour. Dickson Road is a local two-lane, two-way no-through road that connects Hart Road to the industrial and recreational land uses to the east of the Proposal Site.

The average annual weekday traffic volumes on the Hunter Expressway are shown in Table 17.2. Heavy vehicles account for approximately 14 per cent of the total traffic volume travelling along the Hunter Expressway.

Table 17.2: Average annual weekday total traffic volumes (Transport for NSW, 2020)

	2018	2019	2020[1]
Eastbound	16,607	17,275	16,287
Westbound	16,824	17,043	16,244
Total	33,431	34,318	32,531

Note:

1. Between January 2020 and November 2020

Near the Proposal Site, the Hunter Expressway and Hart Road both permit 25/26 m B-double and 4.6 m high vehicles. The Hunter Expressway and Hart Road are also part of the oversize overmass load carrying vehicles network (which permits eligible vehicles operating under the Multi-State Class 1 Load Carrying Vehicles Mass Exemption Notice and the Multi-State Class 1 Load Carrying Vehicles Dimension Exemption Notice), with the travel condition that vehicles or combinations exceeding 3.2 m in width are not permitted to travel from Monday to Friday from 5:00 am to 9:00 am and from Monday to Friday from 4:00 pm to 6:00 pm (except on State-wide public holidays).

17.2.2 Public Transport Network

No public transport services operate on Hart Road or the Hunter Expressway in the vicinity of the Proposal Site.

17.2.3 Pedestrian and Cycling Network

No formal off-road pedestrian or cycling facilities are provided on Hart Road or the Hunter Expressway. Site observations identified that pedestrian and cycling volumes are generally zero or very low in the vicinity of the Proposal Site.

17.2.4 Existing Road Safety

Vehicle crash data for the Hunter Expressway and Hart Road was sourced from Transport for NSW's CrashLink database (Transport For NSW, 2020). The crash records comprise self-reported crashes in the most recent five-year period of available data from 1 April 2015 to 1 March 2020.

Key crash statistics include:

- In the five-year period from 1 April 2015 to 1 March 2020, a total of 24 crashes were recorded
- 75 per cent of all crashes resulted in an injury
- No fatal crashes were recorded during the five-year period
- The most common crash type involved vehicles travelling in the adjacent direction (38 per cent of all crashes) followed by vehicles travelling in the same direction (29 per cent of all crashes)
- 25 per cent of crashes occurred in wet surface conditions and 42 per cent of crashes occurred in dark lighting conditions
- Crash rates are low on roads forming part of the proposed access route.

17.3 Impact assessment

17.3.1 Construction

Construction traffic

The following vehicle movements would be generated during construction:

- Light vehicles: passenger vehicles including cars, utility vehicles and light buses to transport workers between the construction site and accommodation. It is assumed that the construction workforce would be drawn primarily from surrounding areas, and accommodation would typically be within a 20 km radius of the Proposal Site. Group transport for workstreams utilising more than 20 persons as well as partial ride sharing may be implemented depending on the construction contractor.
- Heavy rigid: transport of bulk materials including gravel, concrete (or components including sand, gravel and cement)
- Semi-trailer (2 and 3-axle): delivery of structural, mechanical and electrical equipment (other than those requiring oversize transport), temporary offices and lunchrooms
- B double: fuel supply for first fill and commissioning
- Oversize: delivery of major loads, including the gas turbine, generator, generator step-up transformer, exhaust stack segments and large electrical switchroom(s)
- Cranage: assumed two mobile all terrain cranes, one large crawler for peak construction (between September 2022 and May 2023) and two mobile Franna cranes. Two mobile Franna cranes otherwise during other parts of construction
- Heavy machinery: sourced locally and transported via low-loader. Assumed to remain onsite for the duration of individual assignments (e.g. earthmoving equipment).

During construction, access to and from the Proposal Site would be via Hart Road and the Hunter Expressway. Materials and equipment are expected to be transported from the east or Newcastle direction. All construction parking would be accommodated on the Proposal Site or on adjacent properties by agreement with the land holder Hydro Aluminium and/or Industrial Estate Developer.

Forecast traffic generation during construction is summarised in Table 17.3. During peak construction periods, a peak of 200 light vehicle movements is expected during the hours prior to shift commencement (6:00 am to 7:00 am) and after shift end (3:30 pm to 4:30 pm) weekdays. The afternoon peak may be spread over a longer period of time. Saturday morning peaks are expected to be lower than weekday peaks and are not considered further. Approximately 120 total heavy and semi-trailer vehicle movements per day (i.e. 60 inbound trips and 60 outbound trips), spread across standard construction hours, is expected to occur between July 2022 and May 2023.

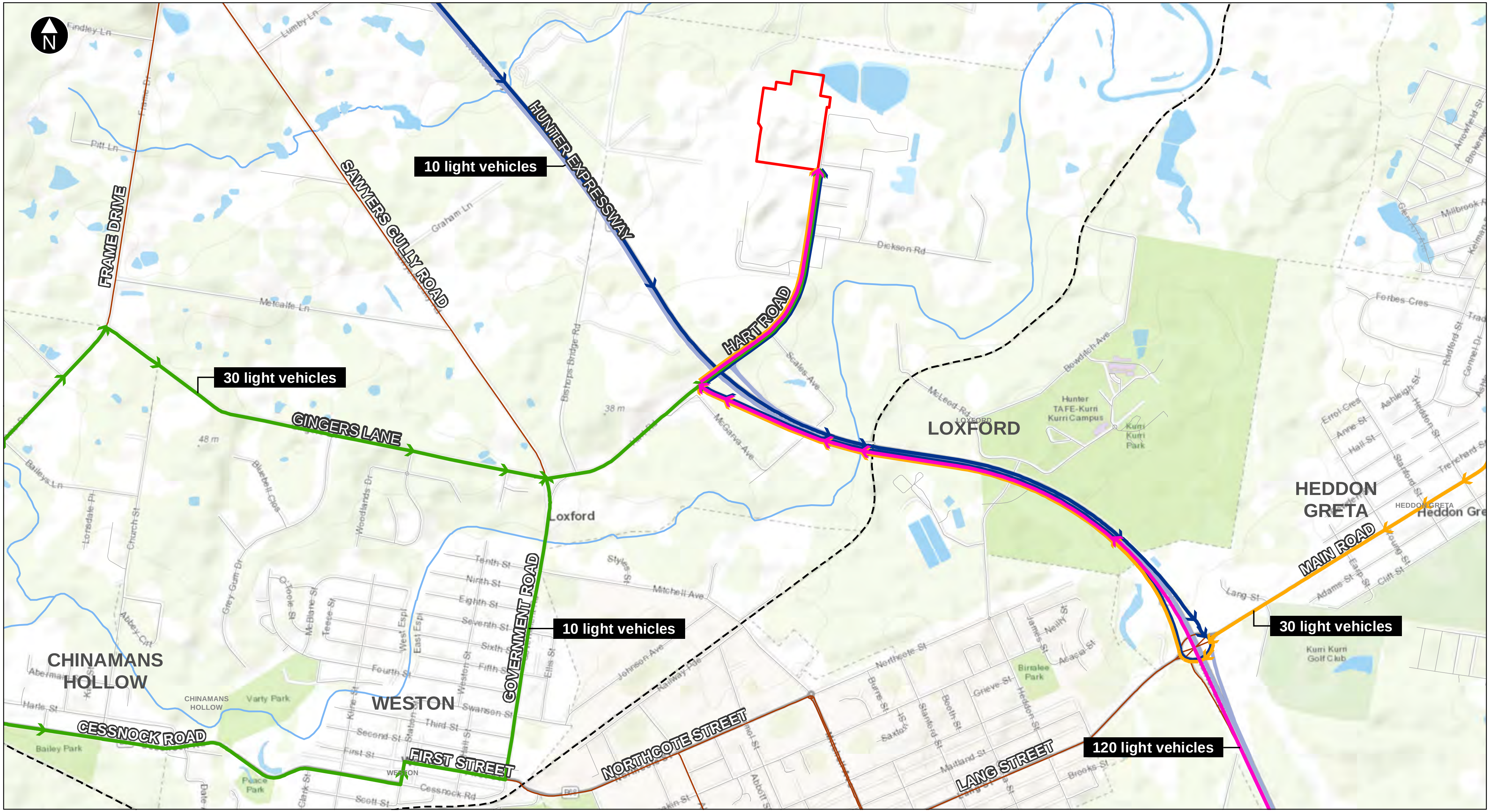
Table 17.3: Construction traffic volumes and timing

Vehicle Class	Maximum vehicle movements (per day)	Peak Timing, AM and PM	Proposal Dates (approx.)
Passenger	400 (200 during each peak hour e.g. AM and PM)	6:00 am to 7:00 am 3:30 pm to 4:30 pm	January 2022 – December 2023
Heavy rigid	100	7:00 am to 3:00 pm	January 2022 – May 2023
Semi-trailer	20	7:00 am to 3:00 pm	July 2022 – May 2023
B-double	12	8:00 am to 4:00 pm	May 2023 – December 2023
Oversize overmass	2	Off-peak (most likely travelling overnight)	September 2022 – November 2022
Cranage	4	Off-peak period	July 2022 – May 2023
Heavy machinery (via low loader)	4	Off-peak period	January 2022 – May 2023

Impacts on road network performance

During peak construction periods, the morning and evening peak weekday hours of construction traffic generation would be the hour prior to shift commencement (between approximately 6:00 am to 7:00 am) and after shift end (between approximately 3:30 pm to 4:30 pm). Approximately 200 light vehicle movements are expected during peak morning and afternoon one hour periods.

Construction workers are most likely to be drawn from the lower Hunter Valley local government areas of Cessnock, Maitland and Newcastle. The assumed distribution of light vehicles during the morning and afternoon peak hours is shown in Figure 17.2 and Figure 17.3.

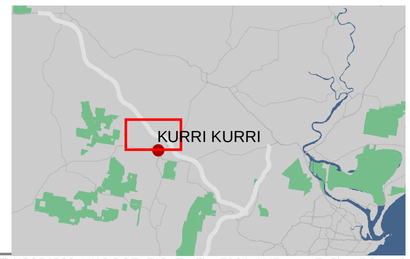


Proposal site
Motorway
Main roads
Roads
Railway
Waterbodies

Light vehicle routes to the Proposal Site
- From Greater Newcastle
- From Cessnock
- From Maitland
- From Singleton

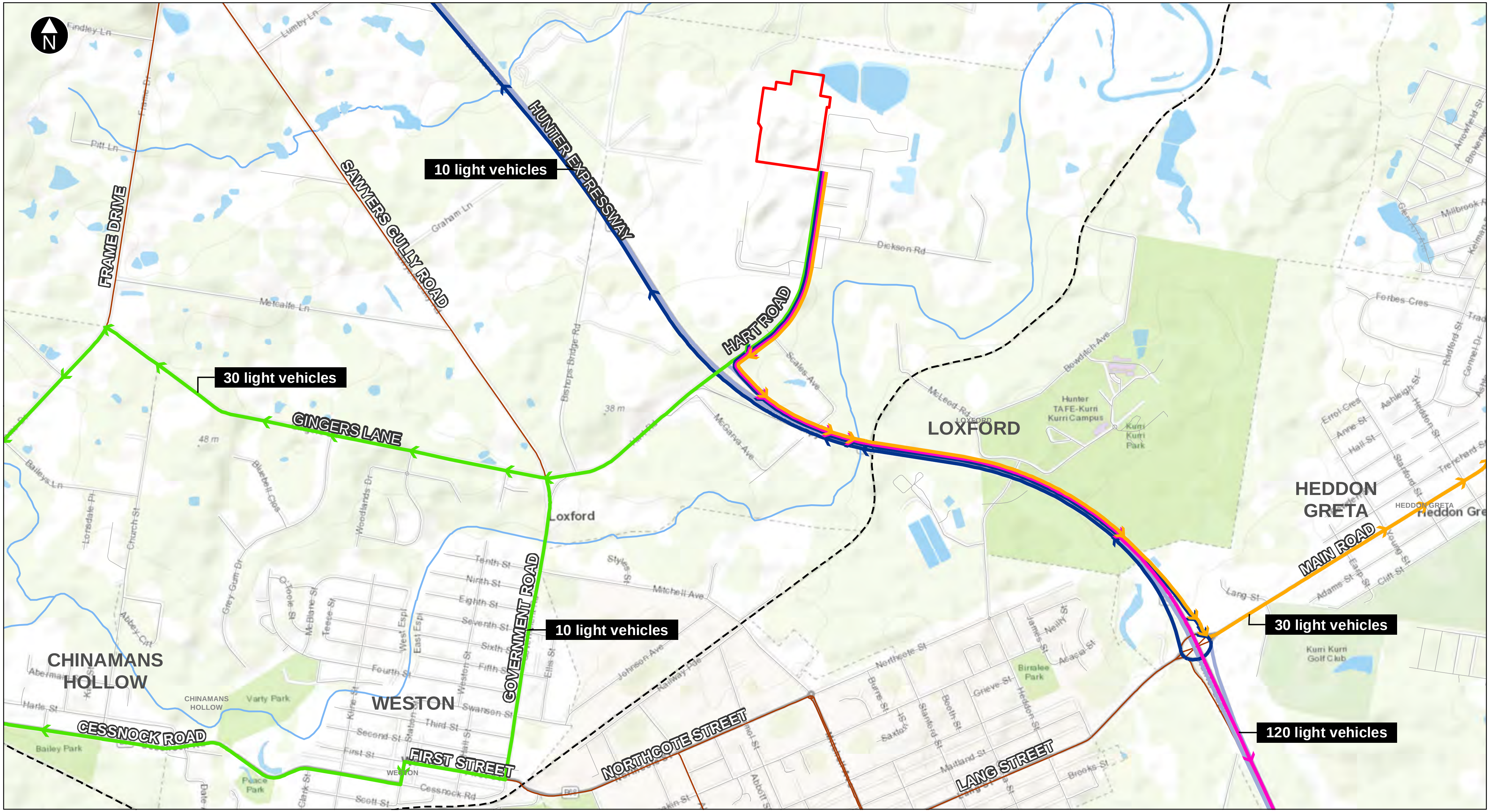
0 0.5 1 km

1:25,000 at A4
Coordinate System: GDA2020 MGA Zone 56



Data sources:
Jacobs 2020
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 17-2 Light vehicle routes to the site - Weekday AM peak hour (6:00 am to 7:00 am) during peak construction



Proposal site	Motorway	Waterbodies	**Light vehicle routes from the Proposal Site**
	Main roads		To Cessnock
	Roads		To Maitland
	Railway		To Greater Newcastle
			To Singleton

0 0.5 1 km

1:25,000 at A4

Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs 2020
Metromap (Aerometrex) 2020
NSW Spatial Services

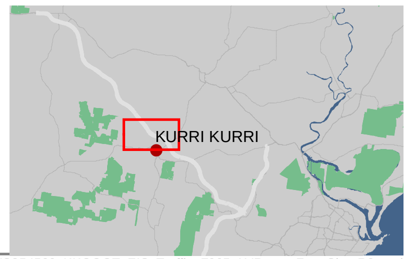
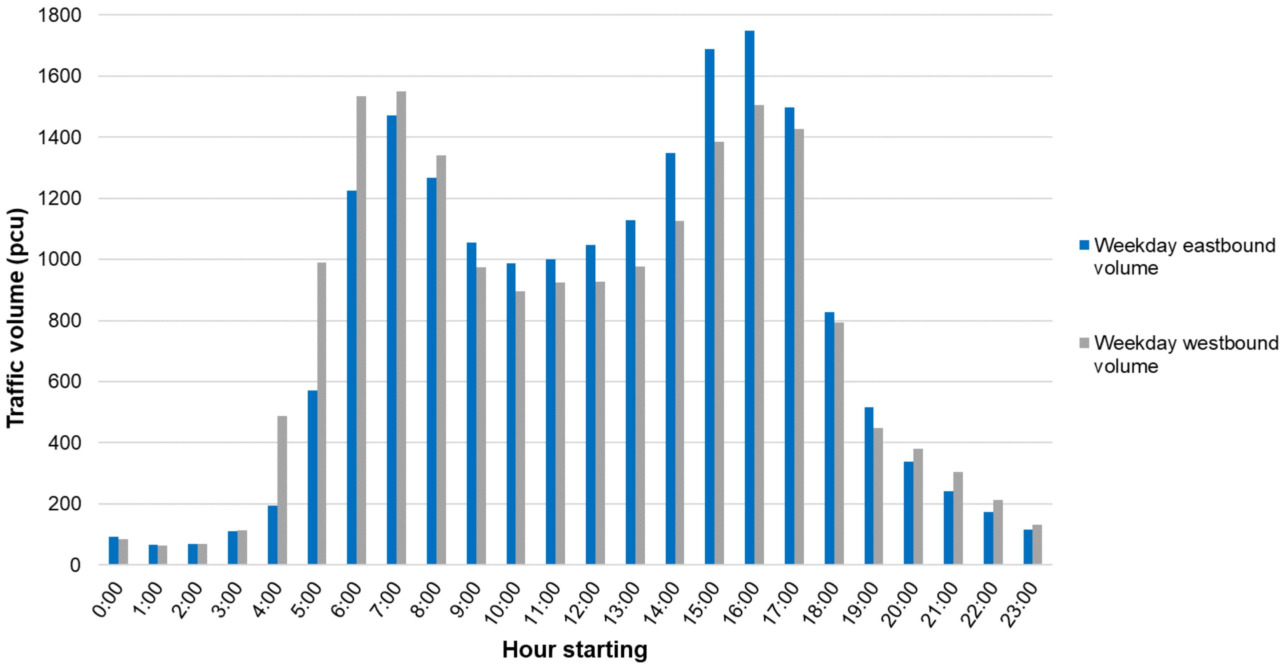


Figure 17-3 Light vehicle routes from the site - Weekday PM peak hour (3:30 pm to 4:30 pm) during peak construction

Hourly traffic volumes on the Hunter Expressway on an average weekday are shown in Figure 17.4. The maximum hourly traffic volume is approximately 1,750 passenger car units (pcu) per hour in the eastbound direction and approximately 1,550 pcu per hour in the westbound direction.



Source: Transport for NSW (2020)
Note: A pcu factor of 2.4 has been assumed to convert heavy vehicles to passenger car units in accordance with the Roads and Maritime Traffic Modelling Guidelines (Roads and Maritime Services, 2013)

Figure 17.4: Hunter Expressway average weekday traffic volumes (passenger car units)

Additional construction vehicle movements generated by the Proposal are not expected have a large impact on the operation of the Hart Road interchange. The interchange currently carries low traffic volumes and has spare capacity to accommodate additional construction traffic.

No impacts to road access are expected as no public roads are proposed to be closed during construction of the Proposal. Existing access to surrounding land uses and for emergency vehicles would be maintained throughout construction works.

No road upgrades are proposed as part of the Proposal.

Impacts on parking

As discussed in Section 17.3, all construction parking would be accommodated on-site. Therefore, no impacts on parking are expected on the surrounding road network due to the Proposal.

Impacts on public transport

The Proposal would not result in any change or impact to pedestrian or cycling facilities.

Impacts on pedestrians

The Proposal would not result in any change or impact to pedestrian or cycling facilities.

Impacts on road safety

During construction of the Proposal, additional construction traffic has the potential to impact road safety on roads along construction vehicle access routes. This includes construction personnel commuting to and from the Proposal Site as well as heavy vehicles transporting materials and equipment. However, as discussed in Section 17.2.4, existing crash rates on roads forming part of the proposed construction vehicle routes are low. To minimise the impacts of additional construction vehicles on road safety, appropriate driver induction, training, safety measures and protocols would be outlined in a Construction Traffic Management Plan (CTMP) adhered to by construction personnel.

Impacts of oversize overmass vehicles

The use of OSOM vehicles would be required to transport certain oversized equipment for the Proposal from the Port of Newcastle (Mayfield #4 Wharf) to the Proposal Site. This includes delivery of equipment such as the gas turbine, the generator, the generator step-up transformer, exhaust stack segments and large electrical switchrooms. It is estimated that approximately 20 vehicle movements in total (e.g. 10 inbound trips and 10 outbound trips) would be required during the construction phase. OSOM vehicle movements are expected to occur overnight.

The likely OSOM vehicle route from the Port of Newcastle has been assessed against the *NSW OSOM load carrying vehicles network map* (Transport for NSW, 2020). The most likely OSOM vehicle route is shown in Figure 17.5. This route would exit the Port of Newcastle via the A43 Industrial Drive, perform a U-turn at Old Maitland Road on the Pacific Highway, enter the A37 Newcastle Inner City Bypass at Sandgate, before joining the A15 Newcastle Link Road at Jesmond, onto the M15 Hunter Expressway and exiting the Expressway (most likely needing to utilise the centre crossover approximately 600 m east of the off ramp and travel 'contra-flow' under traffic management conditions for a short distance) and turning right onto Hart Road.

A detailed description of this route is included in Appendix M.

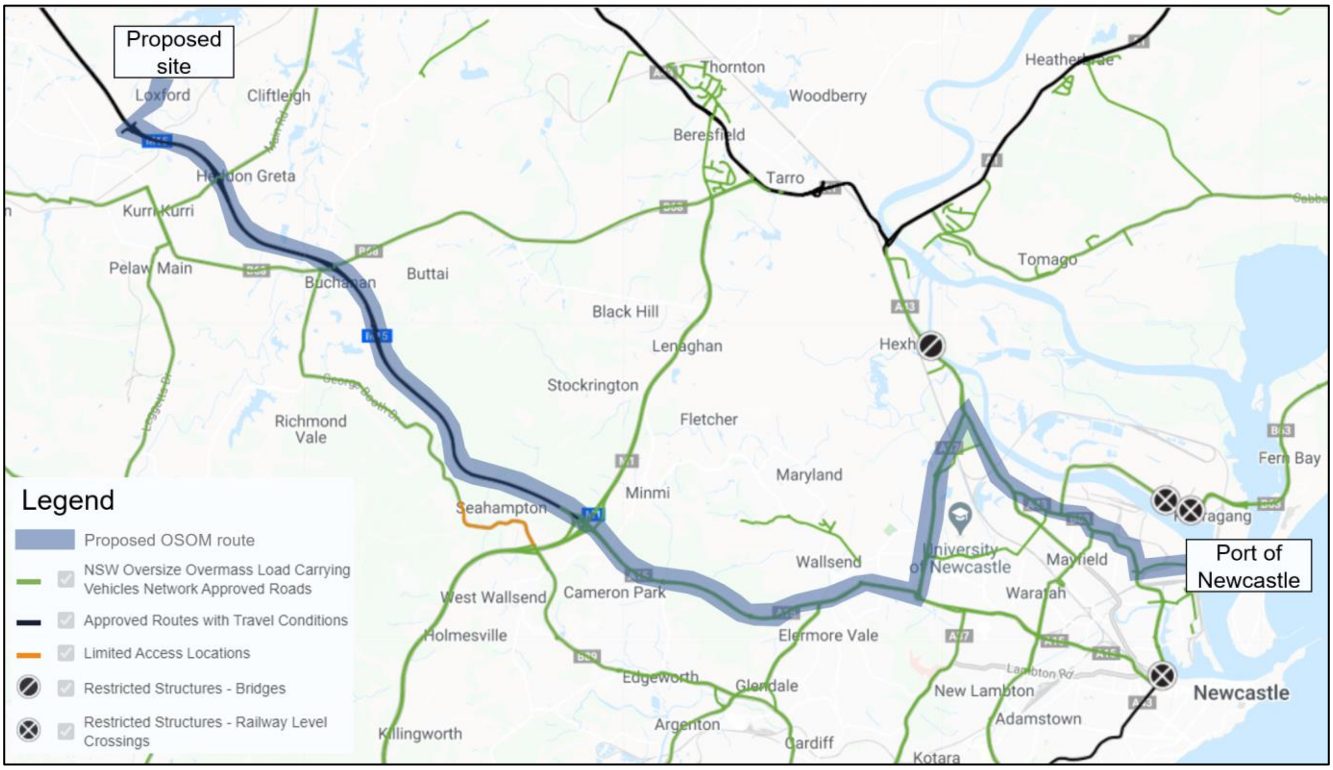


Figure 17.5: Proposed OSOM vehicle route

OSOM vehicle movements would be required to comply with the following:

- *Additional Access Conditions: Oversize and overmass heavy vehicles and loads* (Transport For NSW, 2020) including pilot or escort requirements
- Preparation and adherence to a separate OSOM Transport Management Plan as the OSOM movement is classified as high-risk due to the total combination weight
- Full route survey assessment including review of allowable heights, bridge/overpass capacities, etc.
- State-wide oversize holiday curfews
- Rail Infrastructure Manager approval (if the proposed route is required to travel over a railway level crossing).

To manage these OSOM vehicles, a permit would be sought from the National Heavy Vehicle Regulator (NHVR). This permit would undergo a separate approval process and a suitable contractor would be engaged for transportation. As part of the permit, the contractor would develop a separate OSOM Transport Management Plan and determine the suitable route based on the required OSOM vehicle dimensions and mass in consultation with Snowy Hydro and the NHVR. These traffic movements would be undertaken at night under police escort and in accordance with any OSOM permit conditions.

The OSOM Transport Management Plan for the movement of these OSOM vehicles would be undertaken to identify risks and minimise impacts to the wider road network. The plan would cover as a minimum:

- Identification of route
- Escort measures and procedures
- Times of transporting to minimise impacts on the road network
- Communication strategy and liaising with emergency services and police.

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

The Oversize Overmass Load Carrying Vehicles Network map and online information does not provide information or guidance regarding height clearances above 4.6 m. As such, the identified route is still subject to approval from the NHVR. Potential turbine manufacturers have been consulted and advised their equipment can be suitably configured for transport to the Proposal Site.

17.3.2 Operation

Operational traffic

Typical operation of the Proposal would involve permanent onsite staff performing regular office based work, maintenance, functional tests and facility upkeep activities between approximately 7:00 am and 4:00 pm on weekdays. However, staff numbers are expected to be approximately10 full-time equivalent persons. As such, typical operation would generate an estimated 10 light vehicle trips during the hour before shift commencing and in the hour after shift ending. A small number of additional vehicle movements of support staff, deliveries of consumables, waste disposal, sanitary services, and specialist maintenance staff may also be generated on a weekly basis.

At specific intervals throughout the operational lifetime of the Proposal, additional traffic would be generated by the following activities:

- Diesel fuel delivery: B-double road tankers would be used to refill the onsite diesel storage tanks if and when they are used. The refilling of the storage tanks is dependent on the frequency and duration that the power station is run on diesel and is highly variable but could be expected to occur up to three times annually.
- If unused, diesel may need to be replaced at approximately 12 to 24 month intervals (depending on the condition of the diesel). For planning and assessment purposes the assumption is a maximum of six tankers will enter the Proposal Site each day (12 movements total), until the tanks are drained and refilled.
- GT overhaul: there would be a need to undertake periodic minor inspections, hot gas path inspections and major inspections of each gas turbine and auxiliaries. The timings of each would be largely dependent on the equivalent operating hours, starts per year, operating conditions and the service agreement philosophy adopted. The major overhaul event may increase staff numbers by up to 30 to 50 workers for a period of approximately six to eight weeks, depending on outage requirements.

During operation, access to and from the Proposal Site would be via Hart Road and the Hunter Expressway. Deliveries are expected to be transported from the east including from Port of Newcastle and it is assumed that workers would be drawn from population centres in Newcastle and the lower Hunter Valley.

All parking would be accommodated on the Proposal Site.

Forecast traffic generation during operation is summarised in Table 17.4. During typical operation, a peak of 10 light vehicle movements is expected during the hour prior to shift commencement (between approximately 7:00 am to 8:00 am) and in the hour after shift end (between approximately 4:00 pm to 5:00 pm).

During potential gas turbine (GT) overhaul activities, approximately 40 light vehicle movements is expected during the hour prior to GT major overhaul shift commencement (between approximately 5:00 am to 6:00 am) and in the hour after shift end (between approximately 4:00 pm to 5:00 pm).

Approximately 12 heavy vehicle (B double) movements (i.e. six inbound trips and six outbound trips) is expected when diesel fuel replacement is required and these would occur between the hours of approximately 8:00 am to 4:00 pm.

Table 17.4: Operational traffic volumes and timing

Event	Vehicle type	Maximum vehicle movements (per day)	Typical Arrival / Departure	Timing
Typical operation	Passenger	20 (10 during each peak hour e.g. AM and PM)	7:00 am / 4:00 pm	Weekdays
Deliveries etc.	Light commercial vehicle	4	Off-peak	Weekly
Diesel fuel refilling	B double (3 axle)	12	8:00 am / 4:00 pm	Daily during or post operation of the GT on diesel, up to 3 times per year
GT major overhaul	Passenger (cars, vans, utilities)	80	6:00 am / 4:00 pm	6-week period, every ~10 years (6 days per week)
GT major overhaul	Heavy rigid (cranes, trucks)	10	Off-peak	Ad-hoc arrivals prior/finish of overhaul, every ~10 years

Operational Impacts

Under typical operation of the Proposal, very low traffic generation is expected for onsite staff performing regular office work, maintenance, functional tests and facility upkeep activities. At specific intervals throughout the Proposal's operational life, additional light and heavy vehicles would be generated for diesel fuel delivery and GT overhaul activities. However, operational vehicle movements are not expected to impact on the operation of the surrounding road network as these roads currently carry low traffic volumes and have spare capacity to accommodate the relatively low increase in operational traffic.

As with construction, operational impacts of the Proposal on road safety are expected to be negligible.

All parking for operational vehicles would be accommodated on the Proposal Site.

No impacts to public transport, pedestrians, cyclists or road access are expected.

Due to the very low amount of traffic generated by typical operation of the Proposal and the nearby former Hydro Aluminium Kurri Kurri aluminium smelter demolition and remediation works, cumulative operation activities are not expected to have a large impact on the operation of the Hart Road interchange nor the operation of the Hunter Expressway. Cumulative impacts on safety are expected to be minimal and no impacts to public transport, pedestrians, cyclists or road access are expected.

17.3.3 Potential cumulative impacts

Former aluminium smelter demolition and remediation

Demolition and remediation of the former Hydro Aluminium Kurri Kurri Pty Ltd land adjacent to the Proposal Site is estimated to be ongoing to late 2023 and therefore concurrent with construction of the Proposal. This has potential to create some construction traffic impacts in the immediate vicinity of the Proposal Site.

The *Hydro Kurri Kurri Aluminium Smelter Demolition and Remediation Project Traffic Impact Assessment* (Hyder, 2016) estimates typical peak hour morning and evening traffic volumes as 25 light vehicles and four heavy vehicles travelling to the site and four heavy vehicles leaving the site. The assessment identified that the Hart Road interchange would operate satisfactorily at a Level of Service A with and without construction traffic generated by the demolition and remediation works and has spare capacity to accommodate additional traffic.

As such, due to the low amount of traffic generated by the demolition and remediation works, cumulative construction activities are not expected to have a significant impact on the operation of the Hart Road interchange nor on the Hunter Expressway. Cumulative impacts on road safety are likewise expected to be minimal and no impacts to public transport, pedestrians, cyclists or road access are expected.

ReGrowth Kurri Kurri rezoning, subdivision and industrial development

The ReGrowth Kurri Kurri rezoning proposal is subject to further approvals, and physical works in relation to future individual developments would be subject to lodgement and approval of separate development applications. Development applications for development of the land following rezoning and subdivision are not expected until 2023, by which time the power station is anticipated to be under construction or even in operation (in late 2023). There are not currently any development applications, nor any further detail around the type of future development that might occur adjacent to the Proposal Site. Therefore, potential cumulative traffic and transport impacts from the ReGrowth Kurri Kurri rezoning, subdivision and industrial development have not been assessed.

17.4 Mitigation measures

The potential impacts on road network performance, parking, access, public transport, pedestrians and cyclists, safety and road condition during construction, cumulative construction and operation of the Proposal are expected to be minimal.

Nonetheless, it is important the traffic and transport impacts are managed and therefore recommended safeguards and mitigation measures are summarised in Table 17.5.

Table 17.5: Summary of environmental management measures

Reference	Mitigation measures	Timing
TT1	A Construction Traffic Management Plan will be prepared and implemented by the construction contractor. The CTMP will include: ▪ Confirmation of haulage routes ▪ Access to construction sites including entry and exit locations ▪ Times of transporting to minimise impacts on the road network ▪ Measures to minimise the number of workers using private vehicles ▪ Employment of standard traffic management measures to minimise short-term traffic impacts expected during construction ▪ Management of oversized vehicles ▪ Site specific traffic control measures (including signage) to manage and regulate traffic movement ▪ Relevant traffic safety measures including driver induction, training, safety measures and protocols ▪ Identify requirements for, and placement of, traffic barriers. ▪ Requirements and methods to consult and inform the local community of impacts on the local road network due to the development-related activities ▪ Consultation with Transport for NSW and Council ▪ Consultation with the emergency services to ensure that procedures are in place to maintain safe, priority access for emergency vehicles ▪ A response plan for any construction related traffic incident ▪ Monitoring, review and amendment mechanisms.	Construction
TT2	To manage oversize overmass (OSOM) vehicle movements, a permit will be sought from the NHVR and a separate OSOM Transport Management Plan will be prepared and will include: ▪ Identification of route ▪ Measures to provide an escort for the loads ▪ Times of transporting to minimise impacts on the road network ▪ Communication strategy and liaising with emergency services and police.	Construction
TT3	Affected parties including emergency services will be notified in advance of any disruptions to traffic and restriction of access impacted by the Proposal's construction activities.	Construction

18. Landscape character and visual amenity

An assessment was completed to determine the potential for any landscape character and visual impacts that may arise due to the Proposal. This chapter was informed by a Landscape Character and Visual Impact Assessment Report (Appendix N), prepared with the objective of meeting the SEARS.

18.1 Assessment methodology

The methodology for the Landscape Character and Visual Impact Assessment Report included defining the visual components of the Proposal that have the potential to contribute to views and visual impact. These components include the power station and associated gas turbine exhaust stacks, access roads, electrical switchyard and construction activity.

The following assessment techniques were utilised to define the visual context of the Proposal:

18.1.1 The Viewshed

The viewshed defines the area or distance from the Proposal where the key physical features may be a recognisable element within a view. The viewshed determines the study area of the assessment as this is the area within which the Proposal would be visible. The viewshed is based on the distance at which the tallest component of a structure would take up less than five per cent of the vertical field of view.

For this assessment, the distance at which approximately 40 m high gas turbine exhaust stacks[2] in the landscape would take up five per cent of the vertical field of view is 4.6 km. Thus, for the purposes of this assessment, the viewshed was defined as the area within 4.6 km of the Proposal Site.

The methodology also defines zones of visual influence (ZVI) which seek to quantify the scale of the potential effects of a development over varying distances and the vertical angle of view. Based on the extent of the viewshed, the ZVI are shown in Figure 18.1 below.

Table 18.1: Zones of visual influence

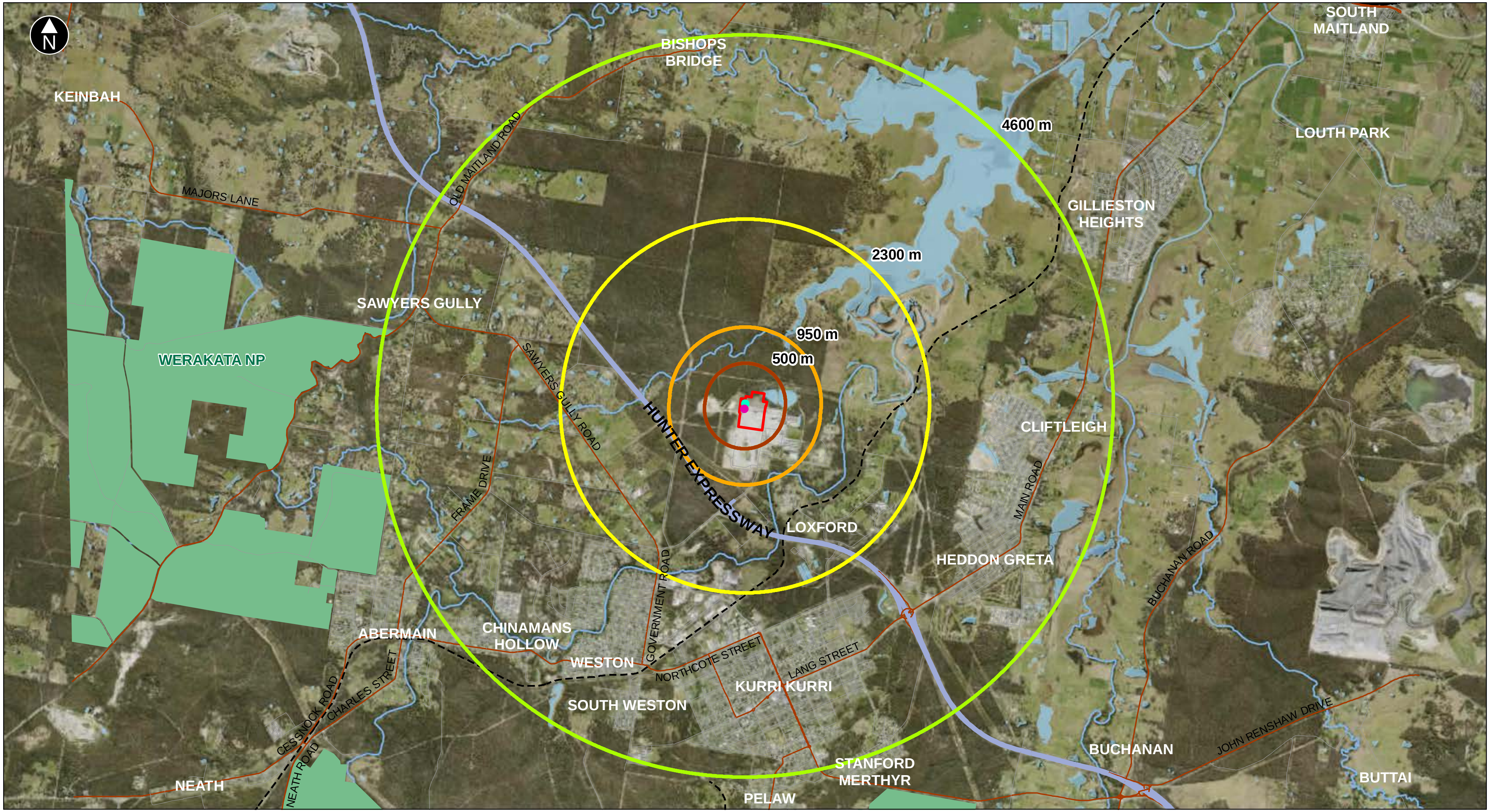
Vertical angle of viewing	Zones of visual influence	Distance from the exhaust stack
<0.5	**Visually insignificant – Limit of the Proposal viewshed** A very small element in the landscape, difficult to discern, invisible in some lighting or weather circumstances.	>4.6 km
0.5-1.0	**Noticeable, but will not dominate the landscape** The degree of visual intrusion will depend on the landscape sensitivity and the sensitivity of the viewer; but would not dominate the landscape.	2.3 km – 4.6 km
1.0-2.5	**Noticeable and can dominate the landscape** Degree of visual intrusion depends on landscape sensitivity and the sensitivity of the viewer.	950 m – 2.3 km
2.5-5.0	**Highly visible and will usually dominate the landscape** Degree of visual intrusion depends on project visibility from the vantage point, and factors such as foreground screening.	500 m – 950 m
>5.0	**Will always be visually dominant in the landscape** Dominates the landscape in which it is sited.	<500 m

[2] The viewshed was based upon the exhaust stacks, which are estimated to have a height of approximately 36 m. For the purposes of conducting a conservative assessment, and to account for potential design changes that may occur during detailed design, the height of the exhaust stacks was rounded up to 40 m for the purpose of establishing the viewshed extent and zones of visual influence distances.

The areas that would be most affected visually by the Proposal are those within 500 m of an exhaust stack.

Figure 18.1 shows the extent of the Proposal's viewshed or visual study area (green circle), with the zones of visual influence in the yellow, orange and red circles.

The zones of visual influence do not determine visual impact. Rather they assist the consideration of the visual scale and prominence of proposed infrastructure over varying distances as one of the criteria considered when determining the overall visual impact of the Proposal.



Proposal site
Exhaust Stack 1
Exhaust Stack 2

ZVI buffers (m)
500
950
2300
4600 (Proposal Viewshed)

Motorway
Main roads
Roads
Railway

Waterbodies
NPWS estate / reserve

0 2 4 km

1:65,000 at A4
Coordinate System: GDA2020 MGA Zone 56

Data sources:
Jacobs 2020
Metromap (Aerometrex) 2020
NSW Spatial Services

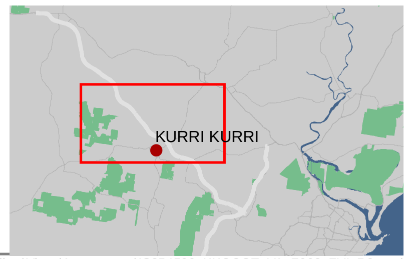


Figure 18-1 Proposal Viewshed and Zones of Visual Influence

snowyhydro renewable energy
Jacobs

Date: 5/03/2021 Path: \\Jacobs.com\ANZ\IE\Projects\04_Eastern\IS354500\22_Spatial\GIS\Directory\Templates\Figures\KurriKurriEIS\Specialists\VisualAssessment\IS354500_KKOCGT_VA_F002_ZVI_R3.mxd
Created by : AA | QA by : KI

18.1.2 Landscape character units and sensitivity

Landscape Character Units are based on the physical characteristics, land use and planning provisions of the area within the viewshed. Features that assist in defining the landscape units and a sensitivity rating include geology, vegetation, topography and drainage patterns, urban development and modification of the landscape. The visual sensitivity of landscape units will depend upon a number of attributes, such as:

- **Location:** The sensitivity of a potential viewer varies according to location. For example, visitors to a National Park where the landscape appears untouched or pristine will be more sensitive to the imposition of new or artificial elements within that landscape. The same viewer travelling along a rural highway, which contains existing examples of modifications and artificial elements, will be less sensitive to the presence of new elements. Modifications or artificial elements are not confined to vertical structures or built form, they also include removal of native vegetation; and visibility of roads, tracks, fences and other rural infrastructure, all of which reduce the sensitivity of a landscape to further change.
- **The rarity of a particular landscape:** Landscapes that are considered rare or threatened are valued more highly by viewers.
- **The scenic qualities of a particular landscape:** Landscapes that are considered scenic are also those that are considered sensitive. They often contain dramatic topographical changes, the presence of water, coastlines, and other comparable features. The presence of modifications or artificial elements (including built form, roads, tracks, fences, and farm sheds), as well as farming practices including land clearing, cropping and burning can reduce the sensitivity of a landscape's scenic qualities.

18.1.3 Photomontage

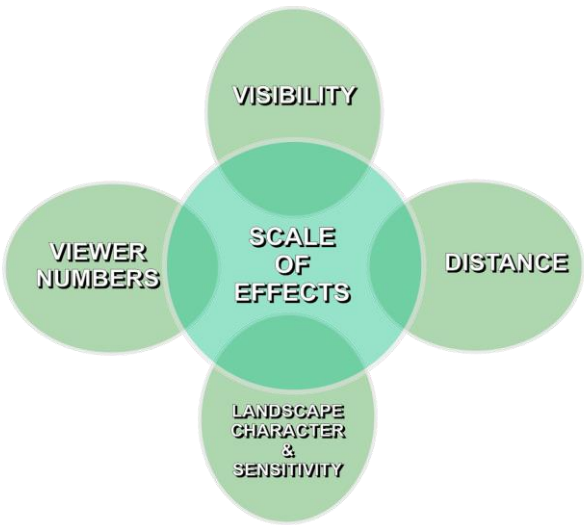
A photomontage was used in the assessment to illustrate the anticipated change to the existing landscape with the Proposal. One photomontage has been produced for the assessment.

The specific methodology and equipment used to develop the photomontage is described in detail in Appendix N.

18.1.4 Viewpoint assessment

The assessment of visual impact from representative viewpoints or viewing locations is based on four criteria:

- **Visibility:** The visibility of the Proposal elements can be affected by other elements in the landscape, such as topography, vegetation, built form and infrastructure.
- **Distance:** Visibility and dominance of the Proposal will decrease with distance.
- **Landscape Character and Sensitivity:** Typically, a modified landscape that is prevalent within the viewshed or the region is less sensitive than one that is ostensibly natural or protected for its environmental, ecological or cultural values.
- **Viewer numbers:** How many people will view the Proposal from a vantage point, and how often? For example, a scenic lookout on a tourist route would attract high viewer numbers.



The overall visual impact is the outcome of the above quantitative criteria that can be measured, balanced by a discussion of the qualitative aspects from each viewpoint.

18.1.5 Scale of effects

The scale of effects determines the overall visual impact, or visual effect, from the assessed viewpoint. These range from nil to high visual impact, as described below:

- **Nil visual impact:** The Proposal will be screened by topography, vegetation or buildings and structures.
- **Negligible visual impact:** Minimal effect that is barely discernible over ordinary day-to-day effects. Usually based on distance. That is, when visible in good weather, the Proposal would be a very small element in a modified landscape, or would be predominantly screened by intervening topography, vegetation or buildings and structures.
- **Low visual impact:** Where the Proposal is noticeable but would not cause significant adverse impacts; i.e. where any one or more of the four criteria (visibility, distance, viewer numbers and landscape sensitivity) are assessed as low. An additional piece of infrastructure in a modified landscape already containing many examples of existing infrastructure would likely result in a low visual impact.
- **Medium/moderate visual impact:** Where any of the four assessment criteria are considered as higher than Low or the visual effects are able to be mitigated from an initial rating of High.
- **High visual impact:** Extensive adverse effects that cannot be avoided, or mitigated. The assessment of a "high or unacceptable adverse effect" from a publicly accessible viewpoint requires the assessment of all criteria to be high. For example, a highly sensitive landscape, viewed by many people, with the Proposal in close proximity and largely visible would lead to an assessment of an unacceptable adverse effect.

18.2 Existing environment

18.2.1 Site location and description

The Proposal Site is flat and situated in a broad landscape with little vertical relief on the edge of the Hunter River floodplain. The land is currently zoned RU2 Rural Landscape under the Cessnock Local Environmental Plan 2011 (Cessnock LEP), with small pockets of surrounding land zoned E2 Environmental Conservation, as shown in Figure 1.3. A large proportion of the land surrounding the Proposal Site, comprising of the former aluminium smelter site, is still owned by Hydro Aluminium (the owners of the former Hydro Aluminium Kurri Kurri Pty aluminium smelter).

The closest residential zoned land is the suburban areas of Kurri Kurri, located approximately 2.5 km south and south-west of the Proposal Site. Further residential areas at Heddon Greta and Cliftleigh are situated approximately 3 km to the east. There are some sparse rural residential properties south and south-east of the Proposal Site, the nearest being located on Dawes Avenue, Loxford just over 1 km south-east of the Proposal Site. The Kurri Kurri Speedway Club is on Dickson Road, Loxford and is approximately 800 m south-east of the Proposal Site.

Immediately south of the Proposal Site are the remains of the former aluminium smelter and the M15 Hunter Expressway. Dense native vegetation surrounds the Proposal Site in the north, east and west. Land further east and north of the Proposal Site comprises low-lying open rural land, and the waterways of Swamp Creek, Black Waterholes Creek and the Swamp Creek wetlands, which lead to the Wentworth swamps and are part of the extensive Hunter River floodplain.

The Proposal Site footprint is mostly within the existing electrical switchyard of the former aluminium smelter. The existing electrical switchyard will be fully decommissioned and removed prior to the construction of the Proposal. The surrounds are primarily flat, with natural drainage falling gradually towards the north-east towards Black Waterholes Creek. There are two large, shallow artificial ponds located north-east of the Proposal Site, which were constructed to capture stormwater runoff from the aluminium smelter site.

18.2.2 Landscape character units and sensitivity

Seven landscape character units have been identified within the viewshed of the Proposal. These have been assessed based on land use, topography and vegetation, and are summarised in the following sections. A more detailed description of each landscape character unit can be found in Appendix N.

Landscape Character Unit 1 – Townships and suburbs

- Townships and suburbs within the viewshed of the Proposal include Kurri Kurri, Loxford, Heddon Greta, Weston, Abermain, Cliftleigh and Gillieston Heights
- Concentration of urban settlement, with a CBD, residential, business and recreation areas, sparsely vegetated
- Local character in Kurri Kurri is expressed and enhanced through murals portraying local scenery including the former aluminium smelter.

Photos indicative of the features of this landscape are shown below in Figure 18.2.

Figure 18.2: Townships and Suburbs Character Images

Landscape Character Unit 2a – Rural Living (Forested flats and gullies)

- Rural living areas characterised by clusters or isolated residential dwellings within the rural landscape
- Primary land use is residential living, rather than agricultural areas
- Large areas of native vegetation have been cleared on some blocks, while others are predominately forested, creating a patchwork mosaic of mostly native vegetation
- Built form includes houses, sheds and occasional agricultural structures such as greenhouses.

Photos indicative of the features of this landscape are shown below in Figure 18.3.

Figure 18.3: Rural Living: Forested Flats and Gullies Character Images

Landscape Character Unit 2b – Rural Living (hills and rises)

- Area around Bishops Bridge, scattered residential dwellings on upper sections of the valley, generally cleared lots surrounded by forested areas
- Some elevated views across the valley floor, taking in views of the floodplain and the distant ranges to the east and south east.

Figure 18.4 below shows the indicative character of this landscape unit.

Figure 18.4: Rural Living: Hills and Rises Character Images

Landscape Character Unit 3 – Lakes, Wetlands and Waterways

- Water bodies and waterways, including ephemeral floodplains. Regular seasonal variation with rainfall and many recorded instances of flooding
- Interconnected mosaic of creeks, rivers and wetlands across the viewshed
- Valued for scenic, recreational and biodiversity values.

Figure 18.5 below shows the indicative character of this landscape unit.

Figure 18.5: Lakes, Wetlands and Waterways (showing Testers Hollow when not in flood) Character Image

Landscape Character Unit 4 – Forested Areas

- Densely vegetated forest areas noted for conservation uses, western and southern edges of the viewshed
- Immersive visual experience for road users and other visitors, with views often confined to the road corridor.

Figure 18.6 below shows an example of this landscape.

Figure 18.6: Forested Areas: Character Image

Landscape Character Unit 5 – Cleared Farmland

- Primarily used for agricultural purposes; built features such as sheds, fences and farm machinery. Few dwellings
- Becoming scarce as suburban development encroaches further into rural landscapes
- Scattered trees and shelterbelt plantings. Regular seasonal changes.

Figure 18.7 below shows an example of this landscape.

Figure 18.7: Cleared Farmland: Character Image

Landscape Character Unit 6 – Industrial and Utility

- Scars of open-cut coal mines and other operating mines and quarries are largely hidden from public view, but are visible from the air
- Mines exist outside of the Proposal viewshed, however related elements, including rail freight lines, cleared easements, transmission infrastructure and other industry are present
- Electricity transmission infrastructure, including high voltage transmission lines and utility-scale substations, are common across the viewshed. Largely hidden by screening vegetation but visible where they cross public roads
- Other industrial precincts in clusters, or on the outskirts of towns.

An example of these industrial areas is shown below in Figure 18.8.

Figure 18.8: Industrial and Utility: Character Image

18.3 Viewpoints and impact assessment

18.3.1 Construction impacts

Construction activities and staging are described in detail in Section 2.4.

Visual impacts during the construction phase would largely be limited to areas that have direct visibility of the Proposal Site, which has been determined by field studies to be limited to a short section of Hart Road and Dickson Road, adjacent to the Proposal Site. Construction activities that require elevated machinery such as cranes may be visible to locations beyond these surrounding roads.

The visual impact of construction activities, which would be temporary in nature, is expected to be low-negligible.

18.3.2 Operation

Landscape character and sensitivity

The landscape within the viewshed includes many constructed elements including dwellings, structures and sheds, transmission infrastructure within cleared easements and other interventions.

The former imposition of the smelter stacks within the landscape and skyline views over the past 50 years reduces the surrounding landscape's sensitivity to the introduction of similar, although smaller, infrastructure in the same location, as proposed. The Proposal's infrastructure is of a character that is familiar to the landscape and surrounding population, in a location that is largely screened from view from public locations. This does not guarantee that the views would necessarily be received positively by local viewers, especially those that have moved to the area since demolition of the former aluminium smelter stacks. However, the sensitivity of this landscape is considered lower than similar landscapes that have not contained prominent, elevated structures.

The landscape sensitivity of a Farmland Landscape Unit that has been highly modified is considered low-moderate. It is common across a large area of New South Wales, but has become encroached upon in the Proposal viewshed by urbanisation. This landscape undergoes visually apparent change both on a regular basis and progressively over time. Rural activities such as grazing, cultivation and other agricultural practices are constant reminders of human influence on the landscape. However, rural landscape character is recognised and protected within the Cessnock LEP 2011 and local strategic documents as a valued scenic landscape. These cleared landscapes in some locations allow long-range views across the landscape to floodplains and distant mountains. The presence of new industrial elements may be perceived by some viewers to have a high visual impact in a rural landscape, notwithstanding that the landscape is already modified by human activity.

The landscape sensitivity of the Forested Areas Landscape Unit is considered medium to high. Although it too is relatively common in the area, it appears more pristine or natural than the Farmland landscape units. The dense nature of the vegetation in these areas forms a buffer against distant views, depending on viewer location.

The Rural Living and Townships Landscape Units are considered to have a moderate-high sensitivity to further visual change. This is due in part to the higher number of residents who may view the Proposal, the extent of visual modifications already brought about, and the presence of similar infrastructure. However, views from these areas to the surrounding landscape are usually screened or filtered by buildings or vegetation. Table 18.2 sets out the sensitivity of the various landscape units within the viewshed of the Proposal.

Table 18.2: Landscape character units and sensitivity

Landscape character unit	Sensitivity
Landscape Character Unit 1 – Townships	Moderate: Land clearing, built form and other visual elements reduce the visual sensitivity of these areas.
Landscape Character Unit 2a – Rural Living (forested flats and gullies)	Moderate: The presence of residential dwellings increases the likelihood of sensitive viewers in this landscape. This landscape is also somewhat modified, by clearing of vegetation in lots, and agricultural, horticultural and equestrian elements.
Landscape Character Unit 2b – Rural Living (hills and rises)	Moderate: The presence of residential dwellings increases the likelihood for sensitive viewers in this landscape. This landscape is also somewhat modified, by clearing of vegetation in lots and paddocks. Some locations afford elevated views across the valley floor to natural features, such as floodplains and distant mountains, as well as built features, such as suburbs.
Landscape Character Unit 3 – Lakes, Wetlands and Waterways	High: The local floodplains are a unique and dynamic element within the landscape. Floodplains clear of vegetation allow long range views across water to the broader landscape.
Landscape Character Unit 4 – Forested Areas	Moderate-High: Although relatively common in the area, it appears more pristine or natural than the Farmland landscape units. The dense nature of the vegetation in these areas buffers somewhat against views to afar features, depending on viewer location.
Landscape Character Unit 5 – Cleared Farmland	Low-Moderate: These areas have been modified by way of clearing for primary industries. They contain fewer dwellings, and therefore fewer sensitive viewers than rural living landscapes. The rural landscape character is a valued scenic landscape in local planning documents.
Landscape Character Unit 6 – Industrial and Utility	Low: These areas contain infrastructure and landscape modifications that lessen the sensitivity of the landscape to further change.

The landscape character units and sensitivity ratings have formed the basis of the assessment of visual impact on views from publicly accessible locations.

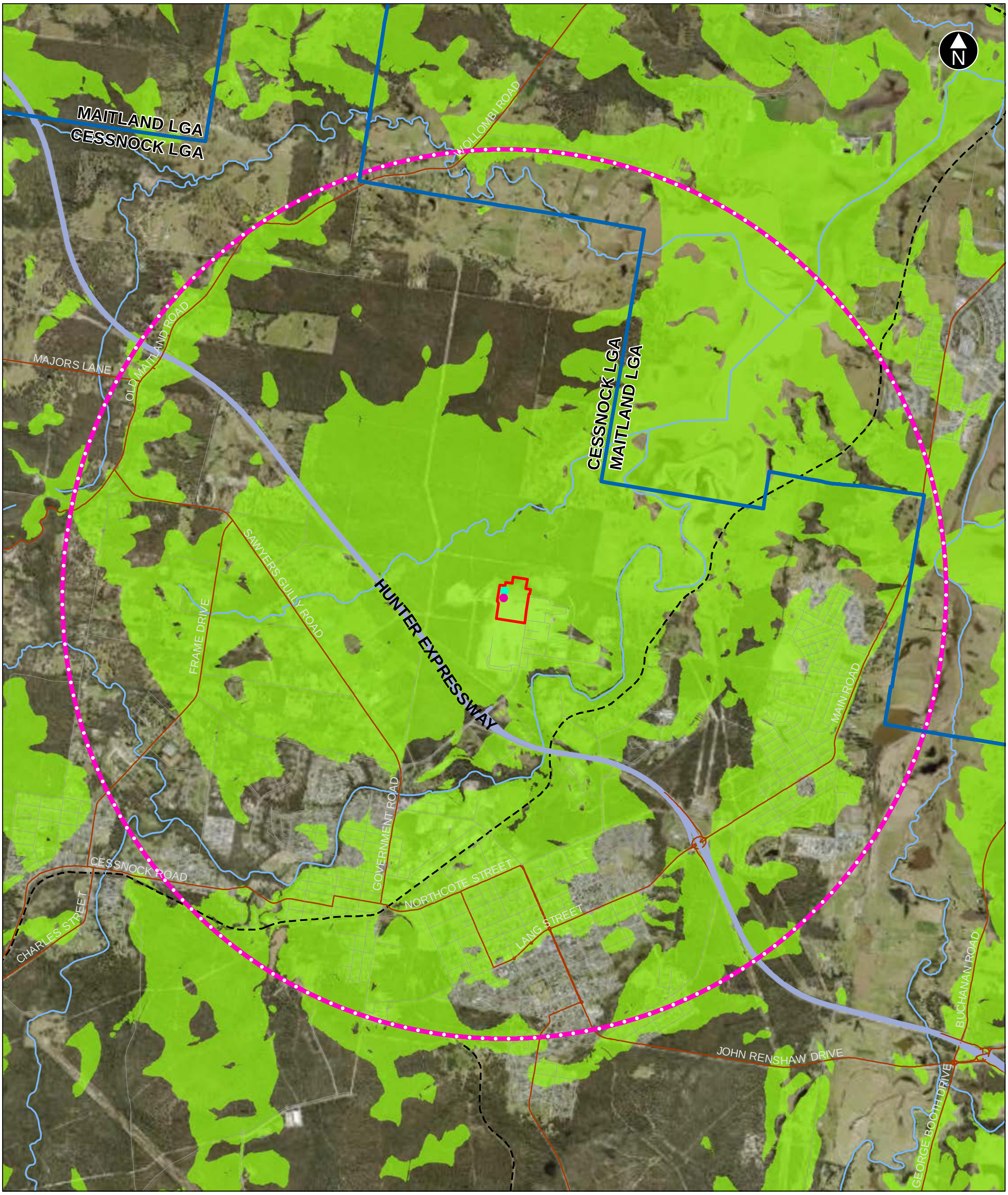
Landscape sensitivity from individual residential properties will always be assessed as "high" as for residents, it is assumed that their home will always be a sensitive location, and the visual landscape must always be considered to have the highest degree of sensitivity to change.

Seen area analysis

The Seen Area Analysis (SAA) identified locations where the Proposal may be visible from the surrounding areas. Visibility of the Proposal depends on the landscape character and features, such as intervening topography and vegetation that may filter or screen views toward the Proposal. The SAA and broad areas of theoretical Proposal visibility are shown below in Figure 18.9. The SAA shows that, due to surrounding topography, and the location of the proposed gas turbine exhaust stacks being within a localised depression, theoretical visibility of the exhaust stacks is afforded to several locations.

These locations include areas within the Kurri Kurri township, areas within Sawyers Gully, areas within Gillieston Heights, Heddon Greta and other areas within the rural landscape. In Kurri Kurri, the main street (Lang Street) of the town centre is aligned along a ridgeline, which restricts visibility further south across the township.

Actual visibility from these areas will depend on other landscape features such as vegetation, or intervening structures that may influence the visibility from these areas. This was assessed using viewpoint assessment.



Proposal site
Exhaust Stack 1
Exhaust Stack 2
Motorway
Main roads
Roads
Railway
Proposal Viewshed
Visible

0 1 2 km
1:55,000 at A4
GDA2020 MGA Zone 56

Data sources:
Jacobs 2020
Metromap (Aerometrex) 2020
NSW Spatial Services

Figure 18-9 Seen Area Analysis

The landscape character of the Proposal Site and immediate surrounds is characterised by the former aluminium smelter site, industrial in character, which is reinforced by the numerous high-voltage transmission lines and easements that bisect the area. These transmission towers are relatively low and tend not to be visible, other than from up close. Elevated elements of the former aluminium smelter were present in views of the site for approximately 50 years until their demolition in 2019. Areas that had visibility of these features may be afforded visibility of the Proposal, but the height of the Proposal's gas turbine exhaust stacks is considerably lower.

While the Proposal Site is (currently) zoned for rural uses, this is at odds with its past, present and likely future industrial character. The Proposal would be largely screened or filtered from public view, where views across rural or other landscapes are available. The Proposal is not likely to impact on the rural landscape character of the study area. There is currently a planning proposal under consideration by Cessnock City Council and the NSW Department of Planning, Industry and Environment, that would rezone the Proposal Site as Heavy Industrial.

The high cover of established vegetation surrounding the Proposal Site and surrounding areas confines most views to the local road corridor for road users. Views to features in the landscape often occur momentarily when travelling through a clearing, then disappear when re-entering a forested area. Due to the vegetation surrounding the Proposal Site, and vegetation, topography and built form in the broader viewshed, potential visibility of the Proposal would be limited to a small number of locations.

Direct views of any elements of the Proposal would be limited to Hart Road and Dickson Road. These views would receive additional screening or filtering of views from the proposed perimeter landscape screening, but views to tall elements would be unavoidable. These views would be within the context of the existing (and likely future) industrial site and industrial precinct, and as such would not be considered intrusive or unexpected.

Visibility of the Proposal from existing residential dwellings would be limited due in part to distance, screening from existing vegetation, and the current zoning of the land tempering the setting and contemplated development that might be expected or considered in views towards the Proposal Site. Residential dwellings at Loxton are within a forested area that screens and filters views toward the Proposal Site. The forested buffer areas surrounding the Proposal Site, and localised vegetation and built form largely filter or screen views from residential areas of Kurri Kurri and the rural residential areas of Sawyers Gully. Few elevated residential dwellings in Gillieston Heights may overlook the Proposal Site, but are outside the viewshed at a distance where the Proposal would not be a dominant feature in the landscape. Existing residential dwellings with potential views of the Proposal would also have overlooked the former smelter. Given the reduced height of the Proposal's tallest elements relative to the height of former aluminium smelter infrastructure, the Proposal's overall visual impact on these dwellings would be considered Negligible to Low.

As the Proposal is in a similar land use category but of a lower scale than the former aluminium smelter, amenity impacts are not expected for residential dwellings in proximity to the Proposal Site. Potential impacts of light spill on residential dwellings would likely be lower than the Proposal Site's former use through the application of current Australian Standards for night lighting, as well as the reduced overall height of the Proposal's structures. The impact of night lighting is considered to be negligible due to the existing and proposed vegetation that surrounds the Proposal Site to the east.

The Proposal's gas turbine exhaust stacks may be visible from some locations in Kurri Kurri and surrounding suburbs. However, these views would likely be from locations that had visibility of the former aluminium smelter's higher stacks and water towers. While the tallest of the former stacks (at 140 m and 70 m) were visible from many locations, the Proposal's 36 m gas turbine exhaust stacks would sit much lower in the landscape, and behind the surrounding vegetation. If exhaust stack aviation lighting is required, this would increase the night-time visibility of the exhaust stack.

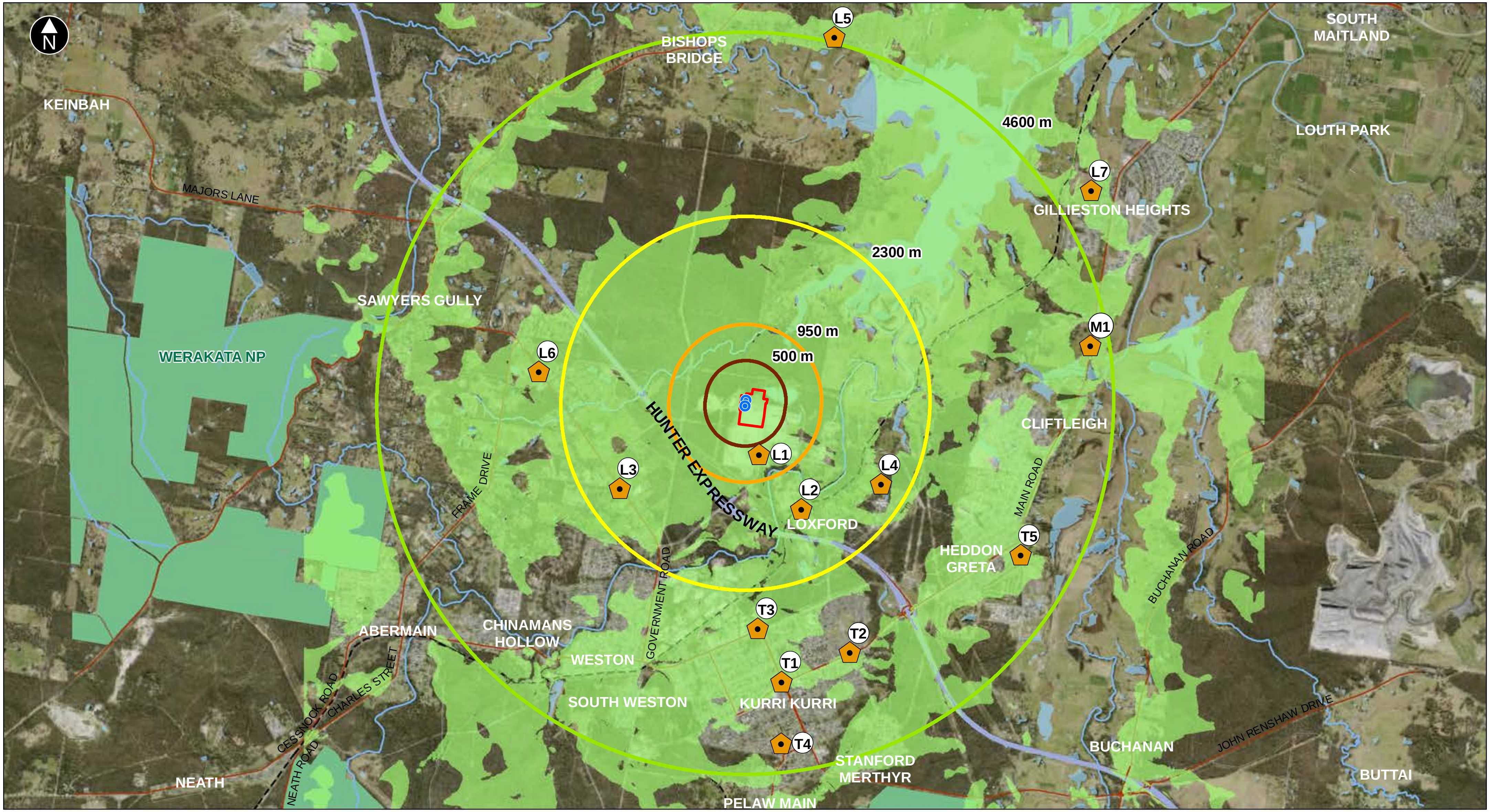
The overall visual impact is assessed as low-negligible. A summary of the viewpoint assessment is included in Table 18.3.

Viewpoint assessment

The viewpoint assessment considered potential impacts from a range of key locations within the public realm, which generally means locations accessible from public roads. Thirteen viewpoints were selected from locations that are accessible by the general public and from where the Proposal may be visible. Viewpoints are categorised as major road viewpoints (M), local road viewpoints (L) and township viewpoints (T). The viewpoints and overall visual impact are listed in Table 18.3, and mapped in Figure 18.10.

Table 18.3: Viewpoint assessment summary

Viewpoint (VP)	Category of viewer	Approx. distance to project elements	Sensitivity	Overall visual impact
Major Roads				
M1 – Cessnock Road	Road Users – High	4.1 km SE	Moderate	Nil – Negligible
Local Roads				
L1 – Hart Road	Road Users – Low	300 m N	Low	Negligible – Low
L2 – McLeod Road	Road Users / Rural Residential – Low	1.0 km NE	Low-Moderate	Low – Moderate
L3 – Metcalfe Lane / Sawyers Road	Road Users / Rural Residential – Moderate	1.6 km NE	Moderate	Low – Moderate
L4 – Bowditch Avenue	Road Users / Rural Residential – Low	1.6 km NW	Low-Moderate	Low
L5 – Ravensfield Lane	Road Users / Rural Residential – Low	4.6 km S	Low-Moderate	Negligible
L6 – Sawyers Gully Road	Road Users / Rural Residential – Low	2.5 km E	Moderate	Negligible
L7 – Cartwright Road	Township Edge / Road users – Low	4.8 km SW	Moderate	Low
Townships and localities				
T1 – Mitchell Avenue / Lang Street	Township Centre / Main Road – Moderate – High	2.5 km N	Moderate	Low
T2 – Lang Street / Heddon Street	Township – Residential – Moderate	3 km N	Moderate	Low
T3 – Mitchell Avenue / Northcote Street	Main Road – Moderate-High	2.5 km N	Low-Moderate	Low
T4 – Centre Oval	Recreational	3.8 km N	Moderate	Nil
T5 – Bill Squires Park	Recreational	3.6 km NW	Moderate	Nil – Negligible



Proposal site

Viewpoints

Exhaust stacks

ZVI buffers (m)

500

950

2300

4600 (Proposal Viewshed)

Motorway

Main roads

Roads

Railway

Waterbodies

NPWS estate / reserve

Visible areas

0 2 4 km

1:65,000 at A4

Coordinate System: GDA2020 MGA Zone 56

Data sources:

Jacobs 2020

Metromap (Aerometrex) 2020

NSW Spatial Services

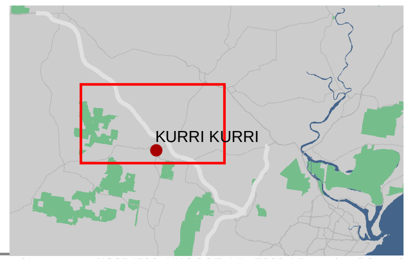


Figure 18-10 Viewpoints Map

snowy hydro renewable energy

Jacobs

From Table 18.3 and Figure 18.10 it can be seen that all of the assessed viewpoints are rated as having Low to Moderate visual sensitivity; and over half are located 3 km or more away from the Proposal Site. This is reflective of the overall character of the surrounding landscape in which topography, vegetation, and the public road layout combine to offer very few vantage points from which the Proposal would be easily visible.

The following section discussed those viewpoints from which the Proposal is likely to have the most impact in terms of overall change to the visual landscape. Assessment is shown below only for locations L1, L2 and L3, the viewpoint locations where the Proposal would be directly visible, or where the overall visual impact has been assessed as Low-Moderate.

Viewpoint L1 – Hart Road

This viewpoint is located near the end of Hart Road, Loxton, and is the closest point to the Proposal Site that can be reached from a public road. Figure 18.11 (top) illustrates the viewpoint without the Proposal, while Figure 18.11 (bottom) presents a photomontage of the Proposal as would be viewed from this viewpoint.

The Proposal is located approximately 500 m north of this viewpoint.

Figure 18.11: Photomontage VP L1 without, and with the Proposal

At this viewpoint, the site of the recently demolished aluminium smelter occupies the left half of the vista. The former aluminium smelter site has been largely cleared of infrastructure, except for the existing electrical switchyard to the north of the site (just visible in the top image), which is also to be demolished, and the Hydro Aluminium offices at the end of Hart Road.

The landscape character at this location is predominately industrial and utility, due to the expansive brownfield aluminium smelter site and the presence of high voltage transmission lines which surround the western and northern perimeter.

Hart Road to the south is largely surrounded by forested areas. The aluminium smelter site is largely filtered from view until entering the clearing near the site. Hart Road joins Dickson Road, which is the connecting road to the Kurri Kurri Speedway approximately 800 m to the east of the Proposal Site. There are currently no other businesses or points of interest that require public access to this area. Visitors to the Kurri Kurri Speedway in previous years would have transited past the former aluminium smelter site.

The photomontage prepared from this viewpoint shows that the Proposal's exhaust stacks and air intake units are visible over the security fencing in this view.

At this viewpoint, the Proposal would be clearly visible. Recognising that the foreground area is also likely to be developed for industrial purposes in the foreseeable future, built form may eventually screen some views to the Proposal Site. At this distance, the exhaust stacks would form a dominant element in an industrial landscape, which would not be out of character with the former or likely future use of this landscape.

The Proposal includes landscape screening along the eastern perimeter, which would soften views toward the Proposal from the northern section of Hart Road and future access roads to be constructed.

There are no sensitive receptors, such as dwellings or public open space in this area.

Recognising that the former and likely future (ReGrowth Kurri Kurri; see Chapters 3 and 4) landscape character of this area is predominately industrial in nature, and that the viewer numbers are relatively low, the Proposal is not considered likely to bring about an unacceptable visual impact or change to the landscape character at this location despite being a dominant element in the landscape.

Viewpoint L1 is summarised in Table 18.4.

Table 18.4: Summary of VP L1

VP L1 – Hart Road		
Distance to Proposal	500 m north	Highly visible and will usually dominate the landscape
Landscape Unit	Landscape Unit 6	Low sensitivity
Viewer Numbers	Local Road	Low viewer numbers
OVERALL VISUAL IMPACT	NEGLIGIBLE – LOW	

Viewpoint L2 – McLeod Road

This viewpoint is located at the level crossing at McLeod Road, Loxton. From this point, the Proposal Site is approximately 1.25 km to the north west.

Figure 18.12 below shows the view looking north east toward the Proposal.

Figure 18.12: VP L2 – McLeod Road looking north west toward the Proposal

This landscape is characterised as rural living (forested flats and gullies). Industrial elements, including the freight rail line and a high voltage transmission line (parallel to McLeod Road, 140 m south) are also present. The former aluminium smelter stacks and water towers would have been visible above the treeline in the background of this view. The prior existence of these elements is considered to lessen the sensitivity of the landscape to receiving similar infrastructure.

Currently, the area contains scattered residential dwellings in a sparsely forested setting. This area is included in the land subject to proposed rezoning of former Hydro Aluminium land as discussed in relation to viewpoint L1, above. There is potential for future residential development in this area, which may increase the viewer numbers and sensitivity, albeit within a landscape that already contains hints of industrial and utility uses.

Vegetation in this area exists in a patchwork forested setting. Vegetation has been cleared in some areas for housing, rear setbacks and the nearby transmission corridor. A forested gully exists between the viewpoint and the Proposal, which would likely be preserved under any proposed rezoning footprint. The retention of this forested area would assist in filtering and screening views toward the Proposal.

At this distance, there is the potential for elevated elements such as the Proposal's exhaust stacks to be visible above the treeline in the background of this view. These views would be similar in appearance to the visibility of the former water towers on the aluminium smelter site. The rest of the Proposal would be screened or filtered by the forested gully.

In the current setting, the visual impact at this location would be low. This recognises the current low viewer numbers, existing and former presence of industrial and utility infrastructure through the area which would have been static elements for current residents until 2019, and only partial potential visibility of the Proposal's exhaust stacks.

Recognising that this area may be subject to future residential development, likely vegetation clearing and a larger residential population (ReGrowth Kurri Kurri; see Chapters 3 and 4), a shift to a more suburban landscape character would increase the sensitivity of the area such that in future, the setting may experience a moderate visual impact. However, given its setting, and the former and likely future industrial nature of the Proposal Site and surrounding area, the Proposal would be considered to have no more than a Low-Moderate overall visual impact.

Viewpoint L2 is summarised in Table 18.5.

Table 18.5: Summary of VP L2

VP L2 – McLeod Road		
Distance to Proposal	1.25 km north west	Noticeable and dominate the landscape
Landscape Unit	Landscape Unit 2a	Moderate sensitivity
Viewer Numbers	Local Road	Low viewer numbers
OVERALL VISUAL IMPACT	LOW-MODERATE	

Viewpoint L3 – Metcalfe Lane/Sawyers Gully Road

This viewpoint is located at the intersection of Metcalfe Lane and Sawyers Gully Road in the Sawyers Gully locality. The Proposal Site is located approximately 1.75 km to the north east.

Figure 18.13 below shows the view looking north east toward the Proposal Site.

Figure 18.13: VP L3 – Metcalfe Lane/Sawyers Gully Road looking north east toward the Proposal

This landscape is characterised as a mix of rural living and cleared, low-intensity agricultural land use. This landscape has been mostly cleared, and contains residential dwellings on large, cleared blocks with small paddocks. Other built form in the landscape includes large sheds, greenhouse structures and equestrian related elements including trotting tracks. A large, lattice steel telecommunication tower exists in views between this viewpoint and the Proposal Site.

Residential dwellings along Sawyers Gully Road would previously have had views of the aluminium smelter infrastructure above the treeline in background views when looking toward the east, which reduces the landscape sensitivity to the introduction of similar infrastructure.

Views to the Proposal Site would be across the modified farming landscape, and largely filtered by the forested areas to the south of the Proposal Site. The Proposal's exhaust stacks may be partially visible above this treeline. At this distance, the Proposal's exhaust stacks would be a noticeable element in the landscape.

Viewpoint L3 is summarised in Table 18.6.

Table 18.6: Summary of VP L3

VP L3 – Metcalfe Lane / Sawyers Gully Road		
Distance to Proposal	1.75 km north east	Noticeable, and can dominate the landscape
Landscape Unit	Landscape Unit 2a	Moderate sensitivity
Viewer Numbers	Local Road	Moderate viewer numbers
OVERALL VISUAL IMPACT	LOW-MODERATE	

18.4 Mitigation measures

Overall, the visual impact of the Proposal is considered Low to Negligible. This is due to the existing landscape character and sensitivity surrounding the Proposal Site and limited visibility of the Proposal from sensitive viewing locations. In addition, the Proposal is consistent with the industrial character of the former aluminium smelter site, and with the planned rezoning and industrial development of the adjacent land.

A number of elements are being proposed to be designed into the Proposal to reduce its visual impact. These include the provision of a 10 m perimeter landscaping buffer along the eastern perimeter of the Proposal site. Landscape screening is an accepted and appropriate design feature to filter or screen views for potentially sensitive viewing locations. This landscaping would be appropriate for filtering or screening views of the lower elements of the proposal from the local road network and any likely future industrial development surrounding the Proposal Site. These elements would include the security fencing, security lighting, buildings, electrical switchyard and the power station. Mature forests surrounding parts of the Proposal Site would also screen nearby views towards the Proposal.

Elevated elements such as the gas turbine exhaust stacks, water tanks and diesel fuel tanks would be partially screened or filtered from view by the existing mature trees surrounding the Proposal Site. The viewpoint assessment has determined that existing vegetation, topography and built form within the viewshed would be effective at screening or filtering most views toward the Proposal across the broader viewshed.

Further visual impact mitigation may be achieved through the following measures (Table 18.7):

Table 18.7: Landscape character and visual amenity mitigation measures

Reference	Mitigation Measure	Timing
LV1	Surfaces and finishes for the Proposal and associated infrastructure will be designed to reduce visual bulk and contrast of large surfaces and elements and allow them to blend into the context of the surrounding area. This may include incorporating contemporary finishes, articulation in long elevations or large facades, alternating colours, or use of contrasting materials.	Detailed design
LV2	Offsite impacts due to light spill from security lighting will be minimised by adhering to Australian Standards (AS/NZ 4282:2019 Control of the obtrusive effects of outdoor lighting), implementing measures such as baffling, downward direction of lighting and sensor-triggering lighting to minimise lighting duration.	Detailed design
LV3	Aviation lighting on the exhaust stacks, if required, will be directional.	Detailed design

19. Socio-economic assessment

A major industrial development such as the Proposal raises the potential for social and economic impacts, both positive and negative, on a locality or region. This chapter provides a summary of the Proposal's likely socio-economic impacts in accordance with the SEARs and relevant guidelines.

19.1 Assessment methodology

The methodology for this assessment has been informed by the requirements of the *Social impact assessment guideline for State significant mining, petroleum production, and extractive industry development* (Department of Environment and Planning, 2017) and the *Draft Social Impact Assessment Guideline State Significant Projects* (Department of Planning, Industry and Environment (DPIE), 2020). DPIE's current (2017) Social Impact Assessment Guideline applies to State significant resource projects. The department has developed an expansion of the 2017 Guideline to standardise the SIA approach across all State significant development, including State significant infrastructure and Critical State significant infrastructure projects. The 2020 draft Social Impact Assessment Guideline is proposed to apply to all State significant projects.

Assessment based on these guidelines involved:

- Describing the existing socio-economic environment of the study area to provide a baseline from which impacts of the Proposal were assessed
- Assessing the potential socio-economic impacts of the Proposal, including both negative and positive impacts. This included consideration of potential impacts on local amenity, access and connectivity, business and communities and potential cumulative impacts. The significance of identified socio-economic impacts was also assessed using the approach outlined in Section 19.3
- Identifying measures to manage or mitigate potential impacts on the socio-economic environment and maximise potential benefits.

19.1.1 Study area

The study area for the socio-economic assessment focusses on the Australian Bureau of Statistics (ABS) Kurri Kurri-Abermain Statistical Area Level 2 (SA2) as shown in Figure 19.1, which includes the suburb of Loxford. Other nearby communities in the Cessnock LGA and Hunter Region are also included where potential impacts, both positive and negative, of the Proposal's construction and operation would also be experienced.

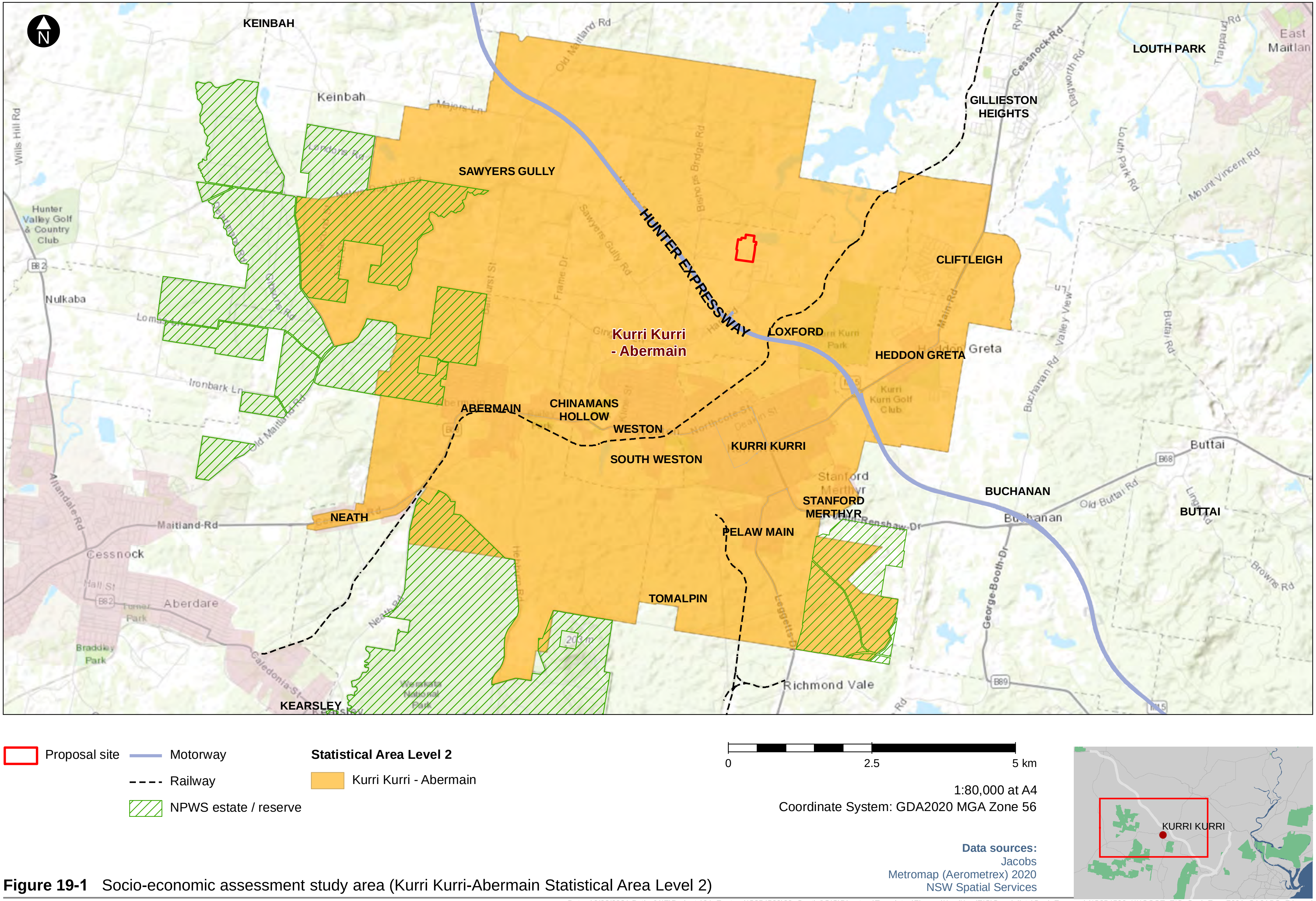


Figure 19-1 Socio-economic assessment study area (Kurri Kurri-Abermain Statistical Area Level 2)

19.2 Existing environment

19.2.1 Regional context

The Hunter Region has traditionally been known for coal mining, power generation, viticulture and horse breeding, although in recent times, the region has developed a reputation for food production and tourism. Newcastle is the main population centre in the region with Kurri Kurri, Cessnock, Maitland and Rutherford being the main towns near the Proposal. Kurri Kurri, Cessnock, Central Maitland and East Maitland are identified in the *Hunter Regional Plan 2036* (DPE, 2016) as important strategic centres in the region. Strategic centres are proposed to be the focus for population and/or economic growth to 2036 (DPE, 2016).

The Cessnock LGA, in which the Proposal is located, is within the Lower Hunter and is located approximately 40 km west of Newcastle. The Cessnock LGA is the focus of the Hunter Region's wine industry and an important tourism destination. Cessnock and Kurri Kurri are the main urban centres in the LGA.

In 2019, the Cessnock LGA had an estimated resident population of 59,895 people, with population growth in the LGA being higher than the NSW average over the 10 years to 2019 (ABS, 2020). The population of the Cessnock LGA is projected to increase to 80,036 people by 2041, a rate of growth marginally above that forecast for NSW as a whole (DPIE, 2019).

19.2.2 Community profile

Key population and demographic data for Kurri Kurri-Abermain SA2 is presented in Table 19.1, along with data for Cessnock LGA and regional NSW (ABS Rest of NSW statistical area) as a comparison.

In 2019, the study area had a total estimated resident population of 18,835 people, which represented about 31 percent of the resident population in the Cessnock LGA. Over the 10 years to 2019, population growth in the study area was above the rate of growth for regional NSW, although marginally below the overall rate of population growth in the Cessnock LGA.

Communities in the study area generally had:

- A population profile consistent with the Cessnock LGA as a whole, but a younger population compared to regional NSW, with a lower median age, higher proportions of children aged under 14 years and lower proportions of elderly people aged 65 years or older
- Higher proportions of people who identified as Aboriginal and/or Torres Strait Islander compared to the Cessnock LGA and regional NSW, and lower levels of diversity in relation to people born overseas and people who speak a language other than English at home
- Relatively high proportions of families with children compared to regional NSW and low proportions of couple only families
- A high proportion of both dwellings that were occupied, and separate houses compared to regional NSW
- Similar proportions of owner-occupied houses to both the Cessnock LGA and regional NSW, and marginally higher proportions of rental housing compared to regional NSW
- Higher levels of households experiencing a level of housing stress compared to regional NSW, with higher proportions of households paying more than 30 per cent of their household income on rent and mortgage payments.

Table 19.1: Population and demographic characteristics

Characteristic	Kurri Kurri-Abermain SA2	Cessnock LGA	Regional NSW
Population and growth			
Observed average annual change (2009-2019)	1.5%	1.8%	0.8%
Estimated resident population (2019)	18,835	59,985	2,777,654
Estimated average annual change (2016-2041)	n/a[1]	1.4%	0.5%
Population projections (2041)	n/a[1]	80,036	3,469,605
Age			
Median age	38 years	38 years	43 years
0-14 years	20.4%	20.5%	18.3%
15-64 years	63.3%	63.0%	61.1%
65+ years	16.3%	16.4%	20.4%
Cultural diversity			
Aboriginal and/or Torres Strait Islander people	7.7%	7.2%	5.5%
Australian born	87.7%	85.7%	80.9%
Speaks language other than English at home	2.8%	3.2%	7.4%
Families and households			
Couple family without children	34.8%	36.5%	42.3%
Families with children (couple families and one parent families)	63.5%	62.0%	56.3%
Total families	4,672	14,393	693,180
Housing			
Total occupied private dwellings	6,317	19,370	980,437
Occupancy rate	92.5%	90.4%	86.8%
Separate houses	90.0%	89.9%	82.2%
Semi-detached, row or terrace house, townhouse, flat, apartment, etc	9.5%	9.1%	15.6%
Other dwelling[2]	0.2%	0.3%	1.5%
Owned outright or owned with a mortgage	68.0%	68.2%	68.0%
Rented	28.4%	33.7%	27.9%
Median weekly rental costs	$280	$280	$270
Households with rent payments greater than or equal to 30% of household income	12.2%	11.6%	10.8%

Characteristic	Kurri Kurri-Abermain SA2	Cessnock LGA	Regional NSW
Households with mortgage payments greater than or equal to 30% of household income	6.1%	6.5%	5.8%

Notes:

1. NSW Government population projections are only available at a LGA level, planning region level or State level and not per ABS Statistical Area.
2. Other dwelling includes caravan, cabin, houseboat, improvised home, tent, sleepers out, house or flat attached to a shop, office, etc.
   Source: ABS 2016 Census QuickStats for Kurri Kurri-Abermain SA2 (106011111), (Cessnock City LGA (LGA11720), and Rest of NSW (1RSW GSSCA), available from https://www.abs.gov.au/websitedbs/D3310114.nsf/Home/2016%20QuickStats, * ABS, 2020, ERP by LGA and above (ASGS 2016), 2001 onwards and ERP by LGA (ASGS 2019), 2001 to 2019, **NSW 2019, NSW 2019 Population projections (LGA and Greater Sydney Region and Regional NSW projections)

19.2.3 Economic profile

Table 19.2 provides an overview of income and employment data for the study area, along with data for the Cessnock LGA and regional NSW.

At the 2016 Census, communities in the study area generally had lower incomes, with median incomes below regional NSW, higher proportions of low-income households and lower proportions of high-income households. At the same time, the study area had relatively high levels of unemployment, particularly compared to regional NSW. About 9.5 per cent of the population aged 15 years or older reported as being unemployed, compared to 8.7 per cent in the Cessnock LGA and 6.6 per cent in regional NSW.

Coal mining was the highest industry of employment for both the study area and Cessnock LGA at the 2016 Census. Social services such as aged care and hospitals were also important industries in relation to local employment, and is likely to reflect the role of Kurri Kurri as a main service centre for communities within the Cessnock LGA. Accommodation was the third highest industry of employment in the Cessnock LGA, which is likely to reflect the importance of tourism to the LGA economy.

While mining has been the main industrial base and source of employment in the Cessnock LGA, the mining industry has experienced a decline over recent times. This has been paralleled by growth in the wine industry and an increase in tourism focusing on food and wine (Cessnock City Council, 2017).

The Proposal Site forms part of the decommissioned Hydro Aluminium Kurri Kurri Pty Ltd aluminium smelter site which operated from 1969 to late 2012 and was permanently closed in 2014. The aluminium smelter was a significant employer and economic influence for Kurri Kurri.

Table 19.2: Employment and income

Characteristic	Kurri Kurri-Abermain SA2	Cessnock LGA	Regional NSW
Income			
Median weekly personal income	$516	$540	$584
Median weekly household income	$1,121	$1,414	$1,168
Households with income <$650/ week	25.3%	24.0%	24.7%
Households with income >$3,000/ week	7.5%	9.7%	10.5%

Characteristic	Kurri Kurri-Abermain SA2	Cessnock LGA	Regional NSW
Employment			
Total labour force	7,603	23,684	1,182,573
Unemployment (%)	9.5%	8.7%	6.6%
Main industries of employment	Coal mining (6.3%) Aged care residential services (3.4%) Takeaway food services (3.4%) Hospitals (except Psychiatric hospitals) (3.3%) Supermarket and grocery stores (3.0%)	Coal mining (8.4%) Aged care residential services (3.2%) Accommodation (2.9%) Hospitals (except Psychiatric hospitals) (2.9%) Takeaway food services (2.7%)	Hospitals (except Psychiatric hospitals) (3.9%) Aged care residential services (2.7% Supermarket and grocery stores (2.6%) Primary education (2.4%) Other social assistance services (2.2%)

Source: ABS 2016 Census QuickStats for Kurri Kurri-Abermain SA2 (106011111), Cessnock City LGA (LGA11720), and Rest of NSW (1RSW GSSCA), available from https://www.abs.gov.au/websitedbs/D3310114.nsf/Home/2016%20QuickStats

19.2.4 Local businesses

The Proposal is generally separate from local businesses with the closest businesses to the Proposal being:

- Loxford Park Speedway, located about 800 m south-east of the Proposal
- A sand blasting business at Dawes Avenue, about one kilometre south of the Proposal
- Businesses within the campus of Kurri Kurri TAFE about 1.8 km south-east of the Proposal (e.g. cafes and bars).

Kurri Kurri includes a wide range of services businesses and retail, commercial, and industrial uses servicing communities and industries within the study area and wider Hunter Region.

19.2.5 Housing and accommodation

In January 2021, rental vacancies in the Hunter Region were at 0.7 per cent, down from 1.4 per cent in January 2020. For the week of 9 February 2021, there were 1,102 rental properties available for rent in the Hunter Region, of which 853 had been available for less than 30 days (SQM Research, 2021; SQM Research, 2021a).

A range of short-term visitor and tourist accommodation options are available in Kurri Kurri and the surrounding towns such as Cessnock and Maitland, including motels, self-contained apartments, hotels, and caravan parks. These provide accommodation for a diverse range of customers including travelling holiday makers, international and domestic tourists visiting the Hunter Valley and business travellers.

In 2018-19, there were 167 accommodation establishments with 10 rooms or more in the Hunter Region, which offered a total of 7,063 rooms. This increased to 169 establishments for the year ending June 2020, offering 7,010 rooms. Room occupancy in 2018-2019 was 67.2 per cent, with this decreasing to 56.1 per cent in June 2020 (Destination NSW, 2019) (Destination NSW, 2020). The reduction in room occupancy rate between 2018-19 and 2020 may reflect restrictions on domestic and international travel within Australia resulting from the COVID-19 pandemic. In addition to accommodation establishments with 10 or more rooms, there are a large number of self-contained apartments, holiday houses, bed and breakfast accommodation, and caravan, camping and holiday parks within the Hunter Region.

The closest visitor accommodation to the Proposal Site is in Kurri Kurri and Abermain, with additional accommodation also available in Cessnock. Newcastle also offers a range of visitor accommodation options within commuting distance from the Proposal.

19.2.6 Social infrastructure

Social infrastructure within two kilometres of the Proposal is generally limited and includes:

- Loxford Park Speedway and Kurri Kurri Speedway Club, located about 800 m south-east to the Proposal site, which hosts monthly club meetings, along with practice and coaching clinics
- TAFE NSW Kurri Kurri, which is located at McLeod Road and offers a range of courses including cookery, veterinary and animal studies, conservation and land management, horticulture, and automotive and vehicle mechanical technology. The campus also has a teaching winery and 1.5 hectare vineyard used by viticulture students.

Kurri Kurri accommodates a range of Council and NSW Government social infrastructure and community facilities to cater for local residents, workers and visitors in the study area and surrounding region. These include:

- Education facilities, including government primary schools, a high school, non-government primary school, tertiary education facility and childcare centres
- Cultural and public attractions such as libraries, museums, and tourist attractions
- Recreation, leisure and sporting facilities including formal sporting grounds, sporting clubs, skate park, aquatic centre and informal recreation uses
- Emergency services, including Ambulance NSW, Fire and Rescue NSW, and NSW Police
- Health and medical services, including Kurri Kurri Hospital, which includes an emergency department, acute inpatient service, rehabilitation services, and specialist medical services.

Communities in the study area also have access to social infrastructure and community facilities in Cessnock, Maitland and regional level services in Newcastle.

19.2.7 Transport and access

Road access to the Proposal Site is via the M15 Hunter Expressway and Hart Road. The Hunter Expressway is a dual carriageway freeway that provides an east-west connection between Newcastle and the Lower Hunter. It provides access for vehicles servicing major resources in the Upper Hunter, residents and businesses of urban centres and towns within the Hunter Region, and tourists and visitors to the Hunter Valley wine region. Within the study area, the Hunter Expressway includes an interchange at Kurri Kurri providing access to Kurri Kurri and nearby communities, and a connection at Hart Road for motorists travelling to/from Newcastle.

Access to the Proposal Site from Kurri Kurri is also provided via Government Road and Hart Road.

Dedicated pedestrian and cycle access near the Proposal Site are limited. Cycle access is mainly provided on road shoulders of main roads, including Hart Road. Short sections of off-road paths are generally provided within Kurri Kurri and surrounding residential areas.

19.2.8 Community values

The Cessnock LGA is largely made up of the traditional lands of the Wonnarua people. The character and identity of Kurri Kurri and the surrounding Cessnock LGA is influenced by the LGA's rural and agricultural industries. The vineyards in the Cessnock LGA comprise Australia's oldest wine region and the wineries are an important focus for tourism activities, attracting international and domestic visitors and day trippers. The study area and surrounding region also includes numerous State Forests, National Parks and Conservation Areas that offer a range of environmental, scenic amenity and recreational values. Protecting and enhancing the LGA's natural environment, the rural character and environmental amenity were identified as important in the *Cessnock 2027 Community Strategic Plan* (Cessnock City Council, 2017).

Industrial uses are also a feature of the LGA's economy, supporting employment and business opportunities for local communities. Encouraging more industry to create local jobs; diversity of economy; and supporting business growth and diversity were identified by community members during consultation carried out by Council for the *Cessnock 2027 Community Strategic Plan* (Cessnock City Council, 2017).

Communities in the study area have access to a wide range of social infrastructure and community services including health care, education, sport and recreation facilities, and cultural uses, as well as community events. These support community health and well-being, and foster social connections. Consultation for the Cessnock *2027 Community Strategic Plan* identified concerns about housing affordability, with the need for cheaper rental accommodation identified (Cessnock City Council, 2017).

19.3 Impact assessment

19.3.1 Construction

During construction, potential social and economic impacts would mainly relate to employment and business opportunities generated by the Proposal, changes to amenity for surrounding uses, and possible influx of construction workers and subsequent demand for accommodation and community services.

Employment

The Proposal would have positive impacts on employment through the creation of direct employment opportunities during the 18-24 month construction phase. Construction of the power station would generate direct employment for about 40-50 workers at the commencement of construction, increasing to about 250 workers at the peak of construction activity (over about a four-to-six month period). The commissioning phase would also require about 40 workers.

The Proposal is also likely to indirectly support generation of employment in local, regional and national businesses and industries from increased economic activity and spending at businesses providing goods and services to support construction activities.

The skills required to support construction would mainly be typical construction industry skills (e.g. labourers, plant and machine operators, tradespeople), with a small number of specialist workers required for specific activities. Where possible, the construction workforce would be sourced from within the study area or surrounding Hunter Region, helping to maximise employment benefits for local and regional communities. As indicated in Section 19.2.3, at the 2016 Census, levels of unemployment in the study area and wider Cessnock LGA were higher than the rest of regional NSW. An increase in local employment on the Proposal, either directly or indirectly, would help to support a reduction in the level of unemployment in the study area and surrounding region.

The creation of employment opportunities from the Proposal also has potential to support improved social and economic outcomes for individuals through increased incomes and possible skills development. The Proposal also has potential to support opportunities to increase the participation of young people, Aboriginal people and women in the construction industry, supporting increased skills development and future employment opportunities for individuals in these groups.

Local business

During construction, potential benefits for businesses would mainly be associated with provision of goods and services to support construction activities (e.g. equipment hire, speciality trades, fuel supplies, transportation, administrative services etc). Spending with local suppliers for construction related activities would help to support local business growth and development within the study area and surrounding region. Increased spending by workers on such things as accommodation, food and services is also likely to impact positively on businesses in the study area and surrounding communities.

As previously indicated, the construction workforce would be sourced mainly from the study area and wider Hunter Region. However, it is expected that some workers would also be required from outside of the wider Hunter Region, for example to supplement any gaps in local skills or capacity for speciality tasks. The use of existing visitor accommodation to accommodate the workforce from outside of the Hunter Region is likely to have positive impacts on owners of these businesses, by providing a base load demand. Cafes, restaurants and eateries are also likely to benefit from an influx of construction workers for the Proposal during the construction phase. However, use of visitor accommodation has potential to temporarily reduce the availability of some accommodation types in nearby towns for travellers and visitors, which may have flow on effects for other tourism related businesses. It is expected that these impacts, if any, are expected to be minimal given the relatively low numbers of construction workers expected to require accommodation.

During construction, potential impacts on businesses due to noise, dust and traffic from increased construction activity are not expected given the Proposal site is separated from surrounding businesses.

Housing and accommodation

During construction, the Proposal would generate employment for up to 250 workers. The peak construction phase would generally occur over about four to six months, toward the end of the construction program, with the majority of the construction phase requiring about 50-100 workers.

The majority of the construction workforce is expected to be sourced from communities in the study area and wider Hunter region, including Newcastle. This would help to reduce demand for temporary worker accommodation although, it is likely that some short-term visitor accommodation or rental housing would be needed to accommodate workers from outside of the study area and surrounding region (for example, those required for speciality tasks). This accommodation is likely to be sourced from towns near the Proposal such as Kurri Kurri, Cessnock and Maitland, although some workers may choose to stay further away, such as in Newcastle and surrounding areas. As indicated in Section 19.2.5, the room occupancy rate in the Hunter region was 67.2 per cent in 2018-2019, decreasing to 56.1 per cent in June 2020. Changes to the mining sector in the Hunter Region in recent years is likely to have freed up some capacity in existing accommodation that caters for workers and it is likely that there would be capacity in the existing accommodation sector given the relatively low numbers of construction workers expected to require accommodation. Any impacts associated with increased demand for tourist accommodation are expected to be managed through the use of a variety of accommodation types and locations where workers are accommodated.

It is possible that some construction workers may choose to rent within the study area for the duration of the works. This has potential to increase pressure on rental prices, particularly in the context of existing low rental vacancy rates within the Hunter Region (refer to Section 19.2.3). Increases in rental costs may affect the availability of affordable rental housing and rental affordability for some groups on low or fixed incomes (e.g. unemployed, elderly, students), contributing to rental housing stress for some households or result in some households having to move to more affordable accommodation elsewhere. However, any such impacts from increased demand for rental accommodation is likely to be low given demand for rental accommodation near the study area by workers is expected to be minimal.

Social infrastructure

The proposal is generally removed from social infrastructure and community facilities, with the nearest community facility being the Loxford Park Speedway and Kurri Kurri Speedway Club, located about 800 m from the proposal. As such, noise, dust and traffic from increased construction activities are not expected to affect the use or enjoyment of social infrastructure in the study area.

The study area, the wider Cessnock LGA and Hunter Region accommodates a high level of community services and facilities, including health and medical services, emergency services, cultural facilities and sporting and recreation facilities. Potential impacts on existing Council and NSW Government social infrastructure and community services due to increased demand by construction workers is unlikely, given the size of the construction workforce in relation to the existing populations of Kurri Kurri, the Cessnock LGA and Hunter Region. Where possible, the construction workforce would comprise existing residents from the wider Hunter Region, which would help to reduce the size of the non-resident workforce required for the Proposal.

Transport and access

Construction of the Proposal would generate construction traffic associated with the haulage and delivery of construction materials and equipment, transport of construction workforce, and general site activities. Construction vehicle movements generated by the Proposal are not expected to impact on the operation of the Hunter Expressway (refer Chapter 17).

Increased construction traffic has potential to impact on road safety for road users. It is likely that residents and workers in the study area are familiar with the presence of heavy vehicles due to the presence of major mining industries. However, the wineries of the Hunter Valley are an important focus of tourism activities attracting international and domestic visitors and day trippers, who may be less familiar with local road conditions. To minimise the impacts of additional construction vehicles on road safety, a Construction Traffic Management Plan would outline suitable controls to be adhered to by construction personnel. Further information about potential construction traffic impacts is contained in Chapter 17.

Community values

Construction activities for the Proposal are not expected to result in significant construction noise, dust or lighting impacts for nearby communities, with the nearest dwellings generally located more than one kilometre from the Proposal Site.

The generally flat terrain and extent of vegetation cover afford few vantage points from which the Proposal Site is visible. During construction, visual impacts (refer Chapter 18) would mainly be limited to areas with direct visibility of the Proposal site at Hart Road and Dickson Road. These impacts would be temporary, and are expected to be minor. The Proposal would be located within a previously disturbed area, although a small amount of vegetation clearing would be required at the switchyard site during the early phases of construction. Protecting the natural environment and environmental amenity of the Cessnock LGA was identified as important during consultation by Council for the *Cessnock 2027 Community Strategic Plan* (Cessnock City Council, 2017) and potential impacts on environmental values from the clearing of this vegetation may be a concern for some people. However, the extent of vegetation required to be cleared for the Proposal would be very low (approximately 2.11 hectares total) in the context of the surrounding area and any impacts on community values would be minimal. Where possible, opportunities to further minimise the amount of vegetation clearance within the Proposal Site would be considered during detailed design.

Local jobs are also important to the community, and the direct and indirect generation of jobs through the construction phase is likely to be seen as a positive by communities in Kurri Kurri and the wider Cessnock LGA, particularly with recent job losses in other sectors of the local economy (refer section 19.2.3).

Evaluation of significance

A matrix was used to evaluate the overall significance of identified socio-economic impacts based on the evaluation of significance matrix within the NSW Department of Planning, Industry and Environment's Draft Social Impact Assessment Guidelines (2020), see Figure 19.2.

		Magnitude level				
		1 Minimal	2 Minor	3 Moderate	4 Major	5 Transformational
Likelihood level	A Almost certain	Medium	Medium	High	Very High	Very High
	B Likely	Low	Medium	High	High	Very High
	C Possible	Low	Medium	Medium	High	High
	D Unlikely	Low	Low	Medium	Medium	High
	E Very unlikely	Low	Low	Low	Medium	Medium

Source: DPIE, 2020

Figure 19.2: Evaluation matrix

The expected magnitude and likelihood levels used are defined in Table 19.3.

Table 19.3: Likelihood and magnitude definitions

Category	Description
Likelihood criteria	
Almost certain	Definite or almost definitely expected (e.g. has happened on similar projects)
Likely	High probability
Possible	Medium probability
Unlikely	Low probability
Very unlikely	Improbable or remote probability
Magnitude level	
Minimal	No noticeable change experienced by people in the locality
Minor	Mild deterioration/improvement, for a reasonably short time, for a small number of people who are generally adaptable and not vulnerable
Moderate	Noticeable deterioration/improvement to something that people value highly, either lasting for an extensive time, or affecting a group of people
Major	Substantial deterioration/improvement to something that people value highly, either lasting for an indefinite time, or affecting many people in a widespread area
Transformational	Substantial change experienced in community wellbeing, livelihood, amenity, infrastructure, services, health, and/or heritage values; permanent displacement or addition of at least 20% of a community

Table 19.4 presents a summary of the social and economic impacts of the Proposal's construction, along with the outcomes of the evaluation of significance. The rating of likelihood and magnitude are combined to determine overall significance of both positive and negative social impacts. The evaluation of magnitude of social and economic impacts is based on the social risk matrix presented in Figure 19.2.

Table 19.4: Summary of social and economic construction impacts and evaluation of magnitude level

Impact	Likelihood	Magnitude	Consequence
Potential impacts on local tourism businesses due to reduced availability of tourist accommodation	Unlikely	Minor	Low
Potential impact on rental prices due to increased demand for rental housing from construction workers	Possible	Minimal	Low
Potential impacts on social infrastructure and community facilities due to increased demand by construction workers	Unlikely	Minimal	Low
Impact on road safety due to increased construction traffic	Possible	Minimal	Low
Amenity impacts on nearby residential uses	Unlikely	Minor	Low
Visual impacts of construction activities	Unlikely	Minor	Low
Impact of construction on community values relating to the environment	Unlikely	Minimal	Low
Positive social and economic impacts			
Creation of direct employment opportunities for local and regional communities	Almost certain	Moderate	High
Indirect benefits for employment due to increased demand for goods and services by construction workers and construction activities.	Possible	Moderate	High
Spending with local suppliers for construction related activities	Likely	Moderate	High

19.3.2 Operation

The Proposal would benefit communities, businesses and industry by increasing the reliability of supply in the NEM. The Proposal would support overall downward pressure on energy prices, supporting reduced electricity costs for households, businesses and industry through NSW and participating NEM jurisdictions over the medium to long term.

During operation, the Proposal would generate permanent employment for about 10 full-time equivalent persons. It is expected that these workers would live locally, helping to support local employment and contribute to the local economy through spending of wages at local and regional businesses. The Proposal would also generate additional contracting jobs during infrequent maintenance events, with major maintenance events requiring a workforce of up to 30 to 50 personnel.

Traffic levels generated by the Proposal's operation would generally be limited to on-site staff, and scheduled maintenance and delivery of diesel fuel and other consumables (see Chapter 17). Any impacts on local transport and access are expected to be minimal (see Chapter 17).

Potential impacts on community values would mainly relate to visual impacts from the presence of the Proposal infrastructure, although potential visibility of the Proposal would be limited to a few locations due to the vegetation surrounding the site, topography and built form of the broader landscape. In particular, visibility of the Proposal from existing dwellings would be limited, due to the distance from the Proposal and screening from existing vegetation. Overall, any potential impacts of the Proposal on existing visual amenity values are expected to be minor. Potential lighting impacts for residential dwellings would be similar or less than the former aluminium smelter use of the site and considered to be negligible due to the existing and proposed vegetation that surrounds the Proposal Site. Further information about potential visual impacts is provided in Chapter 18.

Operational emissions to air and noise from the Proposal would be managed within limits prescribed by the NSW EPA and subject to detailed assessments. The nearest residential areas include rural residential dwellings at Sawyers Gully and Loxford. Operation of the Proposal would be effectively managed with the implementation of attenuation measures for air quality and noise within the Proposal design. Further discussion about each of these aspects is provided in Chapters 15 and Chapter 16.

Evaluation of significance

Table 19.5 presents a summary of the social and economic impacts of the Proposal's operation, along with the outcomes of the evaluation of significance. The rating of likelihood and magnitude are combined to determine overall significance of both positive and negative social impacts. The evaluation of magnitude of social and economic impacts is based on the social risk matrix presented in Table 19.3.

Table 19.5: Summary of social and economic operation impacts and evaluation of magnitude level

Impact	Likelihood	Magnitude	Consequence
Impact on road safety due to increased operations traffic	Very unlikely	Minimal	Low
Changes to visual values	Possible	Minimal	Low
Noise impacts for nearby residential and community uses	Possible	Minimal	Low
Positive social and economic impacts			
Creation of direct employment opportunities for local and regional communities	Likely	Minor	Medium

19.4 Mitigation measures

Mitigation measures to manage potential social and economic impacts of the Proposal's construction and operation are summarised in Table 19.6. Mitigation measures for biodiversity, air quality, noise, traffic and visual amenity are provided in Sections 7.4, 15.5, 16.3, 17.4 and 18.4 respectively.

Table 19.6: Mitigation measures for social and economic impacts

Reference	Mitigation measures	Timing
SE1	The Proponent will identify opportunities to maximise the use of local suppliers, labour and businesses in the provision of goods and services for construction.	Construction
SE2	The Proponent will consult with local accommodation providers to minimise impacts on the tourism sector.	Construction

20. Waste

An assessment of the potential impacts of the waste generated during construction and operation of the Proposal is presented in this chapter. The assessment provides a review of the types of wastes likely to be generated by the Proposal, and describes measures to manage, reduce, reuse, recycle and safely dispose of all identified waste streams.

20.1 Assessment methodology

Assessment of waste streams and waste management for the Proposal is based on interrogation of the materials and processes likely to be used in construction and operation, and the classification of waste materials.

The identification of likely waste streams has involved a review of the likely materials to be used, and the construction methodology. Limited information is available at this stage regarding specific quantities, but no problematic waste streams or volumes are anticipated for the Proposal. Wastes have been attributed to a likely classification based on the EPA Waste Classification Guidelines (EPA, 2014) which is presented in Table 20.1.

Table 20.1: Waste classification guidelines

Waste classification	
Special Waste	Includes waste that has unique regulatory requirements such as asbestos or tyres and includes anything classified as special waste under an EPA gazettal notice.
Liquid waste	Waste (excluding special waste) that has an angle of repose of less than 5 degrees above horizontal, becomes free-flowing at or below 60ºC or when it is transported, is generally not capable of being picked up by a spade or shovel or is classified as liquid waste under an EPA gazettal notice.
Hazardous waste	Hazardous waste (other than special waste or liquid waste) includes waste that is a dangerous good that is classified under the Transport of Dangerous Goods Code as a 'Class 1' to 'Class 8' type of waste. It can also include coal tar or coal tar pitch waste, lead-acid or nickel-cadmium batteries lead paint waste or any mixture containing one of these types of wastes.
General solid waste (putrescible) (GSWp)	GSWp waste (other than special waste, liquid waste, hazardous waste or restricted solid waste) includes standard household and litter bins waste that is collected by or on behalf of local councils, food waste, animal waste, manure and night soil and any grit of screening from sewage treatment systems.
General solid waste (non-putrescible) (GSWnp)	GSWnp waste (other than special waste, liquid waste, hazardous waste, restricted solid waste or GSWp) includes household recyclable waste that does not contain food waste, garden waste, wood waste, waste that was previously in dangerous containers that have been thoroughly cleaned out, virgin excavated material and building and demolition waste.

Waste management for the Proposal would be based on the waste management hierarchy established by the objectives of the *Waste Avoidance and Resource Recovery Act 2001*. Assessment of the various waste streams was based on the waste management hierarchy which follows a sustainable waste management methodology with the aim of reducing waste at all stages of construction and operation of the Proposal. The waste management hierarchy comprises:

- Prevention: Preventing the use of materials and products should be the first point of action when considering reducing waste through introducing management tools or innovative solutions to avoid the unnecessary use of materials.
- Reuse: If materials cannot be prevented from being used, they should be collected and re-used through cleaning, repairing or refurbishing parts to ensure the quality of the item for reuse.

- Recycling: Once a material has reached the end of its lifecycle, materials or products should be sorted and recycled appropriately, as a preferred alternative to disposal.
- Recovery: Waste recovery can be separated into the recovery of materials and the recovery of energy. Materials or energy can be recovered and is generally done in consideration of environment and human health factors.
- Disposal: Disposal should be considered as a last resort when all other opportunities have been explored.

The Proposal is being designed for the lowest waste impact in terms of:

- Appropriate selection of construction materials
- Detailed determination of quantities of materials required
- Balancing earthworks to minimise the demand for imported fill or the need to export/dispose of excess spoil material
- Procurement of materials to favour suppliers who can match precise quantities rather than supply bulk packaging (resulting in over-ordering).

This approach not only reduces the waste impact in procurement, but can also deliver considerable cost savings at the time of purchase, and minimise waste disposal costs.

20.2 Existing environment

Since the closure of the Kurri Kurri aluminium smelter, extensive remediation works have taken place at the site, including Stage 1 of a two-stage demolition program of existing structures, asbestos removal and recycling of waste materials (refer Chapter 11). The Proposal Site's current condition is that of a brownfield site, extensively disturbed by past industrial development. The Proposal would require minimal new disturbance of undisturbed land.

20.3 Impact assessment

20.3.1 Construction

Although the Proposal would be designed and constructed to minimise waste generation, there would be a need for disposal of some wastes. Potential waste streams and impacts during construction of the Proposal may include:

- Generation of green waste, requiring treatment (e.g. mulching or chipping) or disposal
- Generation of inert construction and demolition wastes requiring treatment or disposal
- Generation of virgin excavated natural material (VENM) requiring reuse or disposal
- Generation of hazardous liquid wastes requiring treatment or disposal
- Excess spoil that cannot be reused on site, requiring removal or disposal.

An estimate of some of the main waste streams generated by the above activities during the construction of the Proposal are outlined and classified in Table 20.2.

Table 20.2: Proposed construction waste streams

Material	Estimated quantity	Comments
Packaging (scrap metals, timber and cardboard)	100 tonnes	High-level estimate.
Solid waste to landfill	27 tonnes	Allowance of 0.5 kg/person/day

20.3.2 Operation

Operational waste streams

Operation of the Proposal would also result in the generation of waste from some of the following activities:

- Oily water separators
- Demineralised water plant infrastructure
- Diesel storage and truck unloading facilities
- Cleaning of storage tanks
- Maintenance activities and upgrade/replacement of equipment
- General office/administration, amenities, workshop/storage areas including food and human waste.

The operation of the Proposal would result in the generation of some waste that is captured in equipment like the oily water separator, sumps and pits and needs to be removed from the site, and other chemical wastes like the regeneration of the demineralised water plant, gas turbine compressor wash water and from substances such as scale, sludge and scrapings from the inside of tanks during maintenance activities (although infrequent in nature). Other wastes that are likely to be generated during operation of the Proposal are described below in Table 20.3.

Some liquid waste from the operation of the Proposal, such as compressor wash water, would be managed as trade waste after going through the necessary treatment process. Trade waste volumes and quantities created by the Proposal would be influenced by the chosen technology, which is subject to further contractor involvement and detailed design.

Initial consultation has taken place with Hunter Water in respect to trade waste disposal into the existing Hunter Water sewer network. The Proposal would be subject to a Trade Waste Agreement between Snowy Hydro and Hunter Water, to be executed before the Proposal commences operation, and liquid wastes would be discharged into the existing sewerage system in accordance with such agreement. This agreement would define the quality requirements of the trade waste, which would need to be adhered to during operation and which will dictate the final treatment process and system required prior to discharge.

Table 20.3: Expected operational waste streams

Material	Value	Comments
Sewage	Approximately 0.2 ML/year	Expect 10-hr shift, 5 days per week
Filter grit	Rate of 0.8g/L of demineralisation plant supply	This will depend on the eventual water quality from Hunter Water
Oily water separator waste and turbine wash water	500 kg/yr[1]	
Packaging (scrap metals, timber and cardboard)	1 tonne/year	10% of replacement equipment
Mechanical and electrical (power) equipment	10 tonnes per year[1]	Replacement pumps and drives
Electronics	500 kg/year[1]	Controllers etc.
Landscaping	1 tonne/year[1]	Allowance for grass clippings
Solid waste to landfill	1.260 tonne/year	Office waste: 200 kg/person/year Food waste: 0.2 kg/person/day

Note

1. High-level estimate

Hazardous waste

Certain materials that are likely to be used on the Proposal Site are defined as hazardous either under the Waste Classification Guidelines or the Hazardous Waste (Regulation of Exports and Imports) Act 1989. They have therefore been considered in the Proposal as requiring management or specific disposal requirements.

Hazardous chemicals that may reasonably be on the Proposal Site either within equipment or during maintenance and operation of the Proposal, and which would generate very small volumes of waste, would include:

- Methane (CH_4)
- Carbon dioxide (CO_2)
- Nitrogen (N_2)
- Sulphur hexafluoride (SF_6)
- Acetone (C_3H_6O)
- Aerosols (propellant)
- Acids, hydrochloric acid (HCl) or sulphuric acid (H_2SO_4)
- Caustic, sodium hydroxide (NaOH)
- Chlorine remover, e.g. Sodium bisulphate
- Biocide, e.g. DNBPA based solution
- Antiscalant
- Antifoam
- Fire suppression foam
- Vegetation control, e.g. glyphosate ($C_3H_6NO_5P$)
- Hydrocarbons including diesel, lubricating oil and grease.

Any materials that can be reused or recycled would be separated, collected and taken off site for recycling. Any hazardous waste materials that cannot be reused or recycled, would be disposed of at a suitably licensed waste facility.

Cumulative Impacts

The Proposal would generate waste during construction and operation. Where required, these wastes would be appropriately handled and transported offsite for disposal at a licenced facility, including wastes with potential contaminants and pollutants. As demonstrated by the quantities given in Table 20.2 and Table 20.3 above, the Proposal would not generate volumes of waste during operation that would impact on the capacity of local or regional waste disposal facilities or landfill sites. The Proposal would appropriately treat or dispose of all wastes during operations, in accordance with the conditions attached to an approved Environment Protection Licence. The Proposal is also not expected to impact the environment on site or locally from waste generation.

20.4 Mitigation measures

The following mitigation measures would be implemented to address the potential waste management impacts during construction.

Reference	Mitigation Measure	Timing
W1	A Construction Waste Management Plan (CWMP) will be developed and implemented prior to construction commencement. This will include consideration of a waste management hierarchy, mitigation strategies (avoidance, mitigation, reuse, recycle or disposal), use of materials with minimal packaging requirements, removal of packaging offsite and fabrication of parts offsite and appropriate segregation of any waste materials.	Construction
W2	An Operational Waste Management Plan (OWMP) will be developed and implemented prior to operational commencement. The OWMP will be implemented with consideration of a hierarchical waste management approach, mitigation strategies (avoidance, mitigation, reuse, recycle or disposal), appropriate segregation of any waste materials and a plan to collect general solid waste and hazardous waste from the Proposal Site.	Operation
W3	Any waste that cannot be recovered or recycled will be sorted and taken to a licensed treatment or disposal facility where it will be treated and disposed of according to its classification.	Construction and operation
W4	An audit regime will be implemented, in accordance with the Proponent's Health and Safety Environmental Management System during construction and operation which includes (but not limited to) quantities of waste, storage areas and contractor services.	Construction and operation

21. Cumulative impacts

This section provides an assessment of the potential cumulative impacts of the Proposal and other nearby projects. It also considers supporting infrastructure for the Proposal that is subject to separate approval processes, and decommissioning of the Proposal and rehabilitation of the Proposal Site anticipated after some 30 years of operation.

21.1 Assessment methodology

Cumulative impacts are compounding environmental and community impacts caused by the Proposal when considered in combination with past, present or reasonably foreseeable future activities or projects. Cumulative impacts may arise from the interaction of construction and operation of the Proposal with other nearby concurrent activities or projects. When considered in isolation, impacts of the Proposal may be considered minor. However, these impacts may be more substantial when the impact of other activities or projects on the same receiving environment and communities is considered.

Existing activities and approved or proposed projects nearby that would potentially result in cumulative impacts were identified as:

- Demolition and remediation of the former Hydro Aluminium Kurri Kurri aluminium smelter
- Construction and operation of a gas lateral pipeline and associated gas receiving station to supply the Proposal
- ReGrowth Kurri Kurri's rezoning, subdivision and industrial development proposal.

The assessment of potential cumulative impacts draws on the findings of the impact assessments documented in Chapters 7 to 20 and corresponding technical reports.

21.2 Demolition and remediation of the Hydro Aluminium aluminium smelter

The Proposal Site forms part of the decommissioned Hydro Aluminium Kurri Kurri Pty Ltd aluminium smelter site which ceased operation in late 2012 and was permanently closed in 2014. Demolition of the former aluminium smelter and remediation of the land is an approved State Significant Development, and was the subject of an environmental impact statement that was publicly exhibited in 2016.

The extensive works are ongoing but would be completed within the Proposal Site prior to construction of the Proposal. Demolition and remediation of the former Kurri Kurri aluminium smelter land adjacent to the Proposal Site is estimated to be ongoing to late 2023 and therefore concurrent with construction of the Proposal. This has potential to create some minor traffic, noise, and dust impacts.

As outlined in Section 17.3.3, due to the low volumes of traffic estimated to be generated by the demolition and remediation works, cumulative construction activities are not expected to have a significant impact on the operation of the Hart Road interchange nor on the Hunter Expressway. Cumulative impacts on road safety are likewise expected to be minimal. Construction traffic within and immediately adjacent to the Proposal Site would be managed in cooperation between Snowy Hydro and Hydro Aluminium.

Potential noise impacts from the adjacent aluminium smelter demolition and remediation project are expected to be primarily associated with construction traffic during daytime hours, and consequently cumulative noise impacts from this project are expected to be minimal.

Air quality impacts due to construction of the Proposal and the adjacent aluminium smelter demolition and remediation project are expected to be insignificant and temporary. Standard construction site management techniques would be used to ensure dust is minimised and kept to acceptable levels at the Proposal Site boundary. The Proposal Site is separated from residences and other sensitive air quality receivers. In the event that excessive dust cannot be adequately managed during hot and windy weather conditions, construction activities would be paused until it can be controlled.

21.3 Gas lateral pipeline and gas receiving station

The gas lateral pipeline forms part of the CSSI declaration for the power station Proposal, but construction and operation of the pipeline and associated gas receiving station to supply the Proposal are subject to a separate third party assessment and approval process at a later date. The buried gas lateral pipeline would be approximately 15 to 20 km in length stemming from the existing Jemena North Trunk gas transmission pipeline between Sydney and Newcastle, south of the Proposal Site. In addition to conveying gas to the Proposal, the gas lateral pipeline also serves to store gas for the Proposal. Depending on the location of the gas pipeline compression station/s, sections of the gas pipeline would serve as the gas storage vessel for the Proposal. If the gas compression station is located in the vicinity of the Proposal, then a pipeline loop would be required to act as the gas storage "bottle". Construction and commissioning of the gas lateral infrastructure is expected to be completed after that of the Proposal.

While the pipeline alignment would be selected to minimise social and environmental impacts, some residual impacts are expected. The impacts of the gas lateral pipeline would mostly affect different environments and communities compared to the Proposal.

While the gas receiving station (GRS) is subject to a separate third party assessment and approval process at a later date, the GRS is proposed to be located in the south-western corner of the power island footprint within the Proposal Site and potential cumulative impacts include hazard and risk, and noise.

The GRS has been included in the current Preliminary Hazard Assessment (Chapter 10.1 and Appendix E). This includes consideration of the flammable gas inventory, dangerous goods inventory and credible major hazard events.

Based on the current (known) construction scheduling, the GRS will most likely be constructed towards the end of the Proposal's construction phase. Therefore, it is unlikely that the noisiest activities in construction of both projects would coincide. Hence, significant cumulative noise impacts are not expected during construction of the GRS.

The Proposal and the GRS would operate simultaneously. Completed noise modelling found that the GRS would contribute less than 0.1 dB to the noise levels at the boundary of the Proposal Site and hence would not represent a significant cumulative impact.

21.4 ReGrowth Kurri Kurri rezoning, subdivision and industrial development

The rezoning, subdivision and industrial development of land owned by Hydro Aluminium is a master planning proposal by ReGrowth Kurri Kurri to rezone approximately 329 hectares of land at and around the former Kurri Kurri aluminium smelter from Rural Landscape (RU2) to a mix of land use zones including residential and public recreation, business, heavy and general industrial, infrastructure and environmental conservation (B1, B5, IN1, IN3, R2, RE1 and SP2 (in part)), to reduce the minimum lot size from 40 ha to 450 m^2 (in part) and to identify the site as an urban release area. The former operational area of the Kurri Kurri aluminium smelter is proposed to become an industrial estate with heavy and general industrial land uses. The master planning proposal is expected to result in social and economic benefits for Kurri Kurri and the region, predominantly with regard to employment and supporting social infrastructure.

On 1 December 2020 the NSW Department of Planning, Industry and Environment issued a Gateway Determination enabling Cessnock City Council to place the Hydro Kurri Kurri Planning Proposal on public exhibition. Submissions closed on 1 February 2021.

The rezoning proposal and the subdivision of land are subject to further approvals, and physical works would be subject to lodgement and approval of separate development applications that would need to be assessed on their merits by the relevant approval agencies. Development applications for development of the land following rezoning and subdivision are not expected until 2023, by which time the Proposal is anticipated to be under construction or even in operation (by late 2023).

Potential cumulative impacts of the ReGrowth Kurri Kurri master planning proposal have been considered in terms of noise, traffic, landscape character and visual amenity, and hazard and risk.

Potential noise impacts at the boundary of the Proposal Site have been assessed as a precautionary measure in consideration of future development of neighbouring properties (refer Section 6.8 of Appendix L). The highest predicted noise level along the Proposal Site boundary would not exceed the noise criterion for industrial receivers.

If any adjacent properties were occupied prior to or during construction of the Proposal, some vibration impacts may occur. In this case, mitigation measures have been recommended to reduce vibration impacts (refer Section 7.1.2 of Appendix L).

As the master plan is not yet approved and there are not currently any associated development applications, nor any further detail around the type of future development that might occur adjacent to the Proposal Site, potential cumulative traffic and transport impacts have not been assessed.

The landscape character and visual amenity assessment (Chapter 18) and the hazards and risk assessment (Chapter 10) have both assumed, in terms of the applicable land use zoning of the Proposal Site and the likely adjacent future land use context, that the rezoning proposal will be approved.

21.5 Decommissioning of the Proposal

This section refers to decommissioning of the Proposal and rehabilitation of the Proposal Site.

The Proposal has a design operational life of 30 years, which could be extended as dictated by energy market conditions and operational capability of the power station at that time. The SEARs require decommissioning of the Proposal and rehabilitation of the Proposal Site to be considered by the EIS and the current Proposal seeks approval for construction, operation, decommissioning and rehabilitation of the power station. However, at the time of decommissioning, it is expected that the Department of Planning, Industry and Environment (DPIE) and relevant agencies would request that additional requirements are met and some further approvals such as a Decommissioning and Rehabilitation Management Plan would be required.

The National Electricity Rules promote reliability in the NEM by requiring large generators (which would include the Proposal according to the Rules) to advise the AEMO of the expected closure year. It also requires generators to give the AEMO at least three years' notice of their intention to permanently close a generating unit. It is not anticipated that the Proposal would contaminate soils, water or groundwater, and operational processes would be put in place to ensure this. At the time of decommissioning, site specific investigations would be completed to confirm the absence of any contamination caused by the power station activities, or the need for localised remediation. It is anticipated that the Proposal Site would not require remediation, and would continue to be used for other industrial land uses compatible with the adjacent land uses at the time.

In order to address decommissioning requirements and to manage potential environmental impacts, a Decommissioning and Rehabilitation Management Plan would be developed including the following:

- An appropriately sequenced, staged and communicated shutdown procedure to manage operating hazards and risks and manage any potential energy market impacts
- Removal of all gas, fuels, oils and hazardous material
- Planning for future land use

- Soil, surface water and groundwater testing and remediation of any contamination
- Development of mitigation and management measures for decommissioning including management of demolition waste and recycling of materials.

The plan would meet DPIE requirements and be developed in consultation with DPIE, Council, stakeholders and all relevant agencies.

21.6 Infrastructure required for the Proposal subject to separate approval processes

The only major infrastructure required for the Proposal that is subject to separate environmental and planning approvals process is the gas lateral pipeline and associated gas receiving station. The details and likely impacts are outlined in Section 21.3.

As the Proposal would be constructed prior to the development of the proposed industrial estate it would be necessary to connect other utilities and services to the Proposal Site as part of construction of the Proposal. Potable water, sewer, electricity and telecommunications are available nearby at the junction of Hart and Dickson Roads and would need to be extended into the Proposal Site.

21.7 Conclusion

Potential cumulative impacts that may arise from the interaction of construction and operation of the Proposal with other nearby concurrent activities or projects have been assessed in the EIS technical assessments (chapters and supporting technical reports). The assessments found that any cumulative impacts would be minor to negligible.

The proposed gas lateral pipeline to supply the Proposal forms part of the CSSI declaration for the power station Proposal but would be subject to a separate third party assessment and approval process at a later date. The potential impacts of the gas lateral pipeline construction and operation would mostly affect different environments and communities compared to the Proposal.

Redevelopment of the Proposal Site for use as a power station is consistent with the former and planned future land use in the area and will not preclude or affect future land uses in the area.

22. Summary of mitigation measures

Table 22.1 provides a summary of all of the recommended mitigation measures presented throughout Chapters 7 through 20 of the EIS. Combined with site selection and design elements, implementation of these mitigation measures will minimise potential impacts of the Proposal and ensure that residual impacts of the Proposal would be low.

Table 22.1: Summary of mitigation measures

Reference	Mitigation measures	Timing
Biodiversity		
B1	The Construction Environmental Management Plan for the Proposal will include procedures for the demarcation and protection of retained vegetation, including all vegetation outside and adjacent to the construction footprint.	Construction
B2	A pre-clearing inspection will be conducted by a suitably qualified ecologist to confirm the demarcation of limits of clearing are in place, and procedures for the clearing of vegetation and the relocation of flora and fauna.	Construction
B3	A post clearance report, including any relevant Geographical Information System files, will be produced that validates the area of vegetation cleared.	Construction
B4	The Construction Environmental Management Plan for the Proposal will include weed management and control measures in accordance with the *Biosecurity Act 2015*.	Construction
B5	The Construction Environmental Management Plan for the Proposal will include pathogen management measures to prevent introduction and spread of amphibian chytrid fungus, *Phytophthora cinnamomi* and Exotic Rust Fungi.	Construction
Aboriginal heritage		
AH1	During site inductions for the Proposal's construction, all members of the construction workforce will undergo cultural awareness training. The training, to be coordinated by the Contractor's Environmental Manager, will incorporate material provided by the RAPs, with the specific aim of raising awareness of the cultural heritage values held by the local Aboriginal community, in respect of the Proposal Site and surrounding land.	Construction
AH2	In the areas where the deep alluvium will be impacted through piling or bulk excavation works for the Proposal, this will be monitored by an archaeologist and a representative of the Registered Aboriginal Parties (RAPs). Any Aboriginal objects uncovered during these activities will be collected and their location recorded on AHIMS, in accordance with s89a of the *National Parks and Wildlife Act 1974*. The artefact assemblage would be temporarily stored and analysed. Long term management of those objects will be determined by the RAPs.	Construction

Reference	Mitigation measures	Timing
AH3	If skeletal remains are uncovered during the course of works, all work must stop immediately in the vicinity of the remains and the area secured, so that no further harm occurs. ▪ If it is identified that the skeletal remains are likely to be human and are likely to represent a crime scene, the NSW Police must be called in the first instance. The NSW Police will determine the appropriate course of action. ▪ If it is identified that the skeletal remains are likely to be human and are likely to represent Aboriginal ancestral remains, or human remains that would require consideration under the *Heritage Act 1977* (both Aboriginal and non-Aboriginal), both the NSW Police and Heritage NSW must be called. Heritage NSW will determine the appropriate course of action. ▪ Work may not recommence in this area until either NSW Police or Heritage NSW provide authorisation. ▪ If the remains are identified as Aboriginal, discussions and negotiations would need to occur with the relevant Aboriginal communities and Heritage NSW to determine the most appropriate course of action. These discussions would be led by Heritage NSW. ▪ If it is identified that the skeletal remains are not human, appropriate recording must take place and works can continue.	Construction
Non-Aboriginal heritage		
NAH1	All contractors and subcontractors will be made aware of their obligations under the *Heritage Act 1977*.	Construction
NAH2	Should any unexpected non-Aboriginal heritage items be uncovered and identified during the proposed works, works will cease, and the project area be cordoned off. A qualified archaeologist and, if necessary, Heritage NSW (in accordance with s146 of the *Heritage Act 1977*) would be contacted to assess significance and advise on further requirements before work can recommence.	Construction
Hazard and risk		
PHA1	Consideration of hazards, risks and safety will be prioritised in the selection and design processes and equipment specifications, construction, commissioning and operation	Detailed design, construction and operation
PHA2	The findings of the PHA and hazard table compiled during the risk workshop will be considered in future design stages and HAZOP workshops to minimise hazards and risks.	Detailed design, construction and operation
Bushfire prone land		
BF1	Bushfire risk during construction will be managed in accordance with the Hunter Bush Fire Management Committee's (BFMC) Bush Fire Risk Management Plan (BFRMP; Hunter BFMC, 2009). Site bushfire emergency management arrangements will be addressed through the construction contractor's site emergency management plan detailing site evacuation protocols, emergency vehicle access, and water supply for fire fighting	Construction

Reference	Mitigation measures	Timing
BF2	Hot works controls: the Contractor will prepare and implement hot works safety management procedures. Works having the potential to generate sparks or ignite fires will be undertaken on total fire ban days only in accordance with a permit from the NSW Rural Fire Service.	Construction
BF3	Bushfire fuel hazard in the surrounding landscape will be managed in accordance with the Hunter Bush Fire Risk Management Plan. A 10 metre Asset Protection Zone will be established for the Proposal Site, consistent with: ▪ *ISSC3 Guide for the management of vegetation in the vicinity of electricity assets (*Industry Safety Steering Committee [ISSC], 2016, specifications for APZ for substations/switchyards) ▪ *Planning for Bushfire Protection* (NSW RFS, 2019) specifications for renewable energy generation facilities.	Construction and operation
Aviation hazard and plume rise		
AV1	A suitable plume rise symbol will be published on relevant aeronautical navigation charts, to alert pilots to the potential for turbulence in airspace above the Proposal Site.	Operation
AV2	The 'Additional information' section in the ERSA Aerodrome pages for Maitland and Cessnock Airports will introduce notes and/or a diagram in respect of potential for turbulence in airspace above the Proposal Site.	Operation
AV3	The gas turbine exhaust stack structures will incorporate lighting that is to be activated when the power station is operating	Operation
Electric and magnetic fields		
EMF1	Design and selection of all electrical equipment is to minimise EMF levels and comply with the International Commission on Non-Ionizing Radiation Protection (ICNIRP) reference levels.	Detailed design
EMF2	The health and safety aspects of potential exposure to EMF at the Proposal Site will be considered for staff and contractors as part of health and safety management practices.	Operation
Contaminated land		
CLM1	A hazardous materials and spill management plan will be prepared as a sub-plan of the CEMP. It will outline requirements relating to the storage of fuels and chemicals, waste management, as well as training and procedures for incident and spill response.	Construction
CLM2	Contamination risks during operation would be managed through the application of relevant standards for the storage and handling of fuels and chemicals and appropriate engineering design.	Operation
CLM3	Snowy Hydro's Environmental Management System operational controls and procedures, and the Environmental Standards Handbook and associated training and inductions, will be implemented for all site activities having the potential to release contaminants into the environment.	Operation
Groundwater		
GW1	The Construction Environmental Management Plan for the Proposal will address temporary storage and handling of fuels, oils and chemicals, including a Spill Response Plan.	Construction

Reference	Mitigation measures	Timing
GW2	Subject to the outcomes of further geotechnical and groundwater investigations across the site to during detailed design, a dewatering procedure is to be prepared and implemented in the event of excavations encountering perched or shallow groundwater. These detailed design investigations are to also inform the need for excavation methods to address groundwater inflows, if necessary.	Detailed design, construction
GW3	Excavation activities will implement testing and management procedures for potential ASS. The procedures will be set out in an ASS management plan, which will be prepared during detailed design.	Construction
GW4	The Operational Environment Management Plan (OEMP) for the Proposal will include preparation and implementation of a Spill Response Plan that addresses storage and handling of fuels, oils and chemicals.	Operation
Surface water and aquatic ecology		
SW1	A construction erosion and stormwater management plan will be prepared as a sub-plan of the CEMP in accordance with the principles and requirements of *Managing Urban Stormwater – Soils and Construction, Volume 1* (Landcom, 2004), commonly referred to as the “Blue Book”. It will outline measures to manage soil and water impacts including measures to minimise/manage erosion and sediment transport, dust control, design and maintenance of sediment basin/s, dewatering of construction sediment basins and discharge criteria, and management of accidental spills.	Construction
SW2	A construction surface water monitoring program will be developed and implemented during construction in accordance with the ANZG (2018) water quality guidelines.	Construction
SW3	Site specific controls and procedures will be developed and implemented as part of the Operational Environment Management Plan (OEMP) to mimimise the risk to surface and groundwater from stormwater and potentially harmful chemicals. The OEMP will include an emergency spill response procedure, and an uncontrolled water discharge response, monitoring of discharges of oily water separator pit and visual assessment of downstream waterway condition.	Operation
Hydrology and flooding		
HF1	The construction erosion and stormwater management plan will incorporate procedures and schedule for monitoring of the receiving waterway (tributary of Black Waterholes Creek) downstream of the discharge location(s) to identify any evidence of channel erosion and scour	Construction and operation
Air quality		
AQ1	A dust management plan will be developed by the nominated construction contractor and included with the construction environmental management plan for the project.	Construction
AQ2	Construction plant and equipment will be well maintained and regularly serviced so that vehicular emissions remain within relevant air quality guidelines and standards.	Construction
AQ3	Gas turbine plants will adopt and utilise the best available/most appropriate technology for controlling emissions, such as Dry Low Emissions (DLE) burners on the gas turbines for use when operating on natural gas fuel, and using Water Injection (WI) control technology in the gas turbine burners when burning diesel fuel.	Operation

Reference	Mitigation measures	Timing
Noise and vibration		
NV1	A Construction Noise and Vibration Management Plan (CNVMP) will be developed to manage noise during construction. This will include consideration of plant selection, construction hours, plant maintenance, construction traffic and transport, staff awareness, construction staging and monitoring.	Construction
NV2	The acoustic performance of the gas turbine equipment attenuation will be verified and demonstrated through additional noise modelling of the preferred design solution, prior to commencement of construction.	Detailed design
NV3	Noise monitoring of the Proposal post construction will be performed to verify the predicted noise levels at the relevant receivers. These levels will then be used to review and if necessary, improve the equipment and other attenuation requirements and to confirm that the noise attenuation achieves compliance.	Operation
Traffic and access		
TT1	A Construction Traffic Management Plan will be prepared and implemented by the construction contractor. The CTMP will include: ▪ Confirmation of haulage routes ▪ Access to construction sites including entry and exit locations ▪ Times of transporting to minimise impacts on the road network ▪ Measures to minimise the number of workers using private vehicles ▪ Employment of standard traffic management measures to minimise short-term traffic impacts expected during construction ▪ Management of oversized vehicles ▪ Site specific traffic control measures (including signage) to manage and regulate traffic movement ▪ Relevant traffic safety measures including driver induction, training, safety measures and protocols ▪ Identify requirements for, and placement of, traffic barriers. ▪ Requirements and methods to consult and inform the local community of impacts on the local road network due to the development-related activities ▪ Consultation with Transport for NSW and Council ▪ Consultation with the emergency services to ensure that procedures are in place to maintain safe, priority access for emergency vehicles ▪ A response plan for any construction related traffic incident ▪ Monitoring, review and amendment mechanisms.	Construction
TT2	To manage oversize overmass (OSOM) vehicle movements, a permit will be sought from the NHVR and a separate OSOM Transport Management Plan will be prepared and will include: ▪ Identification of route ▪ Measures to provide an escort for the loads ▪ Times of transporting to minimise impacts on the road network ▪ Communication strategy and liaising with emergency services and police.	Construction
TT3	Affected parties including emergency services will be notified in advance of any disruptions to traffic and restriction of access impacted by the Proposal's construction activities.	Construction

Reference	Mitigation measures	Timing
Landscape character and visual impact		
LV1	Surfaces and finishes for the Proposal and associated infrastructure will be designed to reduce visual bulk and contrast of large surfaces and elements and allow them to blend into the context of the surrounding area. This may include incorporating contemporary finishes, articulation in long elevations or large facades, alternating colours, or use of contrasting materials.	Detailed design
LV2	Offsite impacts due to light spill from security lighting will be minimised by adhering to Australian Standards (AS/NZ 4282:2019 Control of the obtrusive effects of outdoor lighting), implementing measures such as baffling, downward direction of lighting and sensor-triggering lighting to minimise lighting duration.	Detailed design
LV3	Aviation lighting on the exhaust stacks, if required, will be directional.	Detailed design
Socio-economic		
SE1	The Proponent will identify opportunities to maximise the use of local suppliers, labour and businesses in the provision of goods and services for construction.	Construction
SE2	The Proponent will consult with local accommodation providers to minimise impacts on the tourism sector.	Construction
Waste management		
W1	A Construction Waste Management Plan (CWMP) will be developed and implemented prior to construction commencement. This will include consideration of a waste management hierarchy, mitigation strategies (avoidance, mitigation, reuse, recycle or disposal), use of materials with minimal packaging requirements, removal of packaging offsite and fabrication of parts offsite and appropriate segregation of any waste materials.	Construction
W2	An Operational Waste Management Plan (OWMP) will be developed and implemented prior to operational commencement. The OWMP will be implemented with consideration of a hierarchical waste management approach, mitigation strategies (avoidance, mitigation, reuse, recycle or disposal), appropriate segregation of any waste materials and a plan to collect general solid waste and hazardous waste from the Proposal Site.	Operation
W3	Any waste that cannot be recovered or recycled will be sorted and taken to a licensed treatment or disposal facility where it will be treated and disposed of according to its classification	Construction and operation
W4	An audit regime will be implemented, in accordance with the Proponent's Health and Safety Environmental Management System during construction and operation which includes (but not limited to) quantities of waste, storage areas and contractor services.	Construction and operation

23. Evaluation of costs and benefits

This Chapter presents an evaluation of the Proposal as a whole, drawing conclusions on the overall merits of the Proposal.

23.1 Justification

The benefits of the Proposal, being improved electricity dispatchability and hence reliability of electricity supply in the NEM, are considered to outweigh any identified adverse impacts in the short and long term. Gas fired generation capacity provides firming of renewable generation projects' intermittent electricity supply to the NEM. Without dispatchable and firming generation or storage capacity, a power system that is solely reliant on intermittent renewable generation will be prone to unacceptable levels of customer supply interruption. Therefore, the Proposal is an important component in the long term transition to renewable energy by facilitating the displacement of carbon based electricity generation. The Proposal would also provide direct and indirect employment opportunities and provide improved environmental outcomes when compared to conventional power generation technologies. The consequences of not proceeding with the proposal would result in the loss of the benefits of the project.

The EIS addresses the issues identified in the Secretary's environmental assessment requirements. The detailed studies documented in this EIS have demonstrated that the Proposal can be built and operated without significant impacts on the community or local environment.

The environmental assessment identifies that the potential Proposal specific impacts and cumulative impacts are predicted to comply with the relevant noise and air quality goals. The Proposal would result in only minor changes to the existing surface water management system and is not predicted to adversely impact on Black Waterholes Creek or Swamp Creek aquatic habitats and ecosystems. As the Proposal would utilise a highly disturbed Proposal Site associated with the former aluminium smelter, clearing of only a relatively small area of native vegetation would be required and it is not expected that any threatened species or endangered ecological communities would be significantly impacted by the proposal. No known Aboriginal sites would be impacted.

While some environmental impacts cannot be avoided, they have been minimised through site selection and design of the Proposal, and would be further mitigated by implementation of mitigation measures.

23.1.1 The suitability of the site

As described in Section 3.6.1, being for electricity generating works, the Proposal would be permissible with consent in the RU2 Rural Landscape zone under the Cessnock LEP 2011, for which the Proposal Site is currently zoned. However, given the Minister's declaration that the Proposal is critical State significant infrastructure, the provisions of Cessnock LEP 2011 do not apply to the Proposal.

The suitability of the Proposal Site is demonstrated in Section 1.4. As a former industrial site, on land that is already highly disturbed, with ready access to existing high voltage overhead electricity infrastructure and a major transport artery, and with few sensitive land uses nearby, the Proposal Site is considered to be ideally suited for this development. Importantly, it is favourable to undertaking the power station development at an alternative site that would be greenfield in nature, and consequently cause significantly greater disturbance to the environment and land-uses.

The Proposal is considered a compatible use of this land and does not conflict with ongoing operations or existing surrounding land uses as described in Section 1.4. Further, the Proposal is considered to be consistent and compatible with likely future land uses surrounding the Proposal Site, under the proposed rezoning master plan by ReGrowth Kurri Kurri (discussed in Section 4.4.4) that is currently under consideration by the DPIE and Cessnock City Council. This master plan would result in the Proposal Site and adjacent land being part of an industrial estate.

23.1.2 Social costs and benefits

The Proposal would have few localised social impacts, but would result in local and regional benefits as described in Chapter 19. While the Proposal would generate additional traffic during construction, the likely volumes of construction traffic would be within the capacity of the local road network and would not result in delays at existing intersections. Similarly, noise associated with construction traffic has been assessed (as described in Chapter 16) as unlikely to impact on amenity of local residents or accessibility.

Construction of the Proposal would generate up to approximately 250 full time equivalent positions at the peak of construction activity, and about 10 permanent full time equivalent jobs during operation. A small number of additional support staff and deliveries of consumables, waste disposal, sanitary services, and specialist maintenance staff may also be generated on a weekly basis. The provision of goods and services to the Proposal throughout its operational life would generate increased economic activity for local and regional businesses.

The Proposal would generate noise during operation and during certain weather conditions might be audible to receivers in the vicinity of the Proposal Site. As discussed in Chapter 16, the Proposal's power island components in particular would be attenuated to ensure sensitive receivers and industrial receivers in the vicinity of the Proposal Site would not be subjected to operational noise in excess of the noise criteria as regulated by the NSW Environment Protection Authority and NSW Department of Planning, Industry and Environment.

The Proposal would introduce a new facility which would be visible from a small number of existing viewpoints in the surrounding area, in particular from those viewpoints where the gas turbine exhaust stacks would be visible. However, at approximately 36 m, the height of the two turbine exhaust stacks would be considerably lower than the 140 m and 70 m chimneys that were associated with the former Kurri Kurri aluminium smelter, which occupied the former Kurri Kurri aluminium smelter site for over 40 years and were adjacent to the Proposal Site. As discussed in Chapter 18, the visual impacts would be limited due to distance from accessible viewpoints, screening vegetation and the mainly flat terrain that permits very few elevated vantage points.

Additional workers during construction of the Proposal may require accommodation but this should not exceed the capacity of the local surrounding townships. Positive social impacts would include the flow-on effects of those workers accessing goods and services in the region.

The Proposal is consistent with the released NSW energy strategy as it builds essential efficiency and reliability into the network, which will be needed during the transition period as existing generation assets are retired. Together, gas peaking and renewable energy generation are part of a group of technologies that will provide emissions reduction while meeting the necessary rapid start up, generation capacity, plant reliability and cost effectiveness necessary to meet NSW electricity demand. The Proposal would benefit communities, businesses and industry by increasing the reliability of supply in the NEM. The Proposal would support overall downward pressure on energy prices, supporting reduced electricity costs for households, businesses and industry through NSW and participating NEM jurisdictions over the medium to long term.

23.1.3 Biophysical costs and benefits

The Proposal would involve the clearing of just over 3 ha of vegetation, of which 1.54 ha is native vegetation. However, as described in Chapter 7, just 0.41 ha or less than one-third of the native vegetation is classed as 'intact'. The remainder is regrowth or ground layer vegetation that is within existing power line easements and subject to regular slashing and maintenance. These impacts would be offset in accordance with the BC Act and in accordance with any approval conditions. No significant impacts on threatened species or communities are predicted.

Stormwater management during construction and operation would be designed to prevent unfiltered runoff entering local creeks and waterways that discharge into the floodplain of the Hunter River. The Proposal Site is above the probable maximum flood levels and due to the proposed detention basin, the flood peaks after development are anticipated to be less than existing peaks. Impacts to downstream aquatic systems including groundwater dependant ecosystems are not anticipated.

The Proposal's operation would generate air pollutant emissions from the combustion of natural gas and diesel fuel. Both of these fuel sources generate emissions of carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_x), sulphur oxides (SO_x), suspended particulate matter (such as PM_{10} and $PM_{2.5}$), and unburnt hydrocarbons and other volatile organic compounds (VOCs). Snowy Hydro has considered the technologies available for controlling emissions from gas turbine plants, and assessment has shown that the best available and most appropriate control technology for these units is Dry Low Emissions (DLE) burners on the gas turbines when operating on natural gas fuel, and Water Injection (WI) control technology in the gas turbine burners when operating on diesel fuel.

With the application of emissions control technology, air quality modelling (see Chapter 15) demonstrated that, under the proposed operating regime, the emitted concentrations of all airborne substances including oxides of nitrogen and particulate matter would be very low relative to background levels and within the prescribed limits. The Proposal would not cause any additional exceedances of EPA ambient air quality criteria.

The Proposal is projected to have a lower emission intensity than the average for all other grid connected fossil fuel powered power stations. The Proposal would also have one of the lowest emission intensities of all Open Cycle Gas Turbine power stations connected to the NEM in Australia. Compared to some of the existing Open Cycle Gas Turbine power stations connected to the NEM, the use of the latest technology F-Class gas turbine design, as proposed, utilises improved turbine blading designs and allows the turbines to operate with higher compression ratios, amongst other design features. These factors contribute to a decreased gas turbine heat rate and subsequently an increased turbine efficiency and improved emissions intensity.

23.1.4 Economic costs and benefits

The Proposal has an estimated capital cost of $610 million. Labour, plant, materials and equipment would be procured from the Hunter Region to the extent this is possible, noting that the gas turbines and their associated components would be imported and some other specialised (imported) labour would also be required. Local benefits would include spending by additional workers required for the Proposal on accommodation, food and services in the local area.

More broadly, the Proposal would facilitate the generation of dispatchable electricity and network services identified as critical to energy security within the NEM. This would support the transition to a low carbon energy future by allowing increased renewable energy generation.

23.1.5 Public interest

Community and stakeholder engagement is ongoing as described in Chapter 5. The Proposal represents investment in the provision of dispatchable electricity and other network services into the NEM. It would maximise long-term social and economic benefits through firming of renewable generation projects' intermittent electricity supply to the NEM, while minimising the short term negative impacts on communities and the environment during construction.

Traffic that would be generated during construction and operation is minimal and would have negligible impact on the local road network. Predicted construction and operational noise levels are within noise management levels during standard hours and out of hours at residential or non-residential receivers. Operational noise impacts would be mitigated through attenuation of the Proposal's power island components in particular. Biodiversity impacts have been reduced by site selection and reuse of former industrial land, and biodiversity credits would be offset in accordance with the BC Act resulting in a neutral or beneficial biodiversity outcome.

As a result, the Proposal is considered to be in the public interest.

A response to submissions report would be prepared to address any issues raised in submissions and this report, along with submissions, are required to be considered by the Minister for Planning and Public Spaces in determining whether to approve the Proposal and, if so, on what conditions.

23.2 Consideration of the objectives of the EP&A Act

The objectives of the EP&A Act, and how these are addressed in relation to the Proposal, are presented in Table 23.1 below. It shows that the Proposal is justified on the basis of its consistency with the EP&A Act.

Table 23.1: Consideration of objectives of the EP&A Act

Objective	Comment
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 Proposal's planning, impacts, design safeguards and mitigation measures detailed in this EIS allow for the proper management, development, consumption and conservation of natural and other resources. The Proposal is aimed at providing long-term positive impacts through provision of dispatchable electricity, while minimising short term and long term environmental impacts. The Proposal would result in some localised operational noise and air quality impacts, and impacts to biodiversity, but these would be avoided or minimised, either through design or, in the case of biodiversity impacts, credits would be offset.
To facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment.	Ecologically sustainable development is considered in Section 23.3.1 and Section 23.3.2 below.
To promote the orderly and economic use and development of land.	This objective is achieved through the beneficial re-use of land that has supported industrial uses for over 40 years. As the former Kurri Kurri aluminium smelter reached the end of its economic life, an opportunity arose to not only re-use the Proposal Site for a purpose that is highly compatible with its previous use, but which may act as a catalyst for encouraging the establishment of other industrial developments on the Hydro Aluminium land, under the current ReGrowth Kurri Kurri rezoning master plan proposal. The Proposal Site is highly disturbed and largely cleared of vegetation. The Proposal's benefits, through providing dispatchable electricity and firming capacity for intermittent renewables, would be achieved with minimal impact on the natural environment or on the amenity of nearby residents. The Proposal is considered a compatible use of the land, and would not conflict with existing nearby land uses or hinder the future orderly and economic use and development of any adjoining land.
To promote the delivery and maintenance of affordable housing.	It is possible that some construction workers may choose to rent within the study area for the duration of the works. This has potential to increase pressure on rental prices, particularly in the context of existing low rental vacancy rates within the Hunter Region (refer to Section 19.2.3). Increases in rental costs may affect the availability of affordable rental housing and rental affordability for some groups on low or fixed incomes (e.g. unemployed, elderly, students), contributing to rental housing stress for some households or result in some households having to move to more affordable accommodation elsewhere. However, any such impacts from increased demand for rental accommodation is likely to be low given demand for rental accommodation near the study area by workers is expected to be minimal.

Objective	Comment
To protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats.	The Proposal has been planned to largely avoid areas of native vegetation. In comparison to developing the power station on a greenfield site, this has resulted in a significant reduction to potential impacts to threatened flora and fauna. The Proposal's impacts on threatened and other flora and fauna species have been assessed in accordance with the BC Act. Snowy Hydro would offset the biodiversity credits as described in Chapter 7.
To promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage).	The Proposal has assessed the potential for impacts on built and cultural heritage. No impacts to built or cultural heritage are likely to occur as a result of the Proposal.
To promote good design and amenity of the built environment.	Design would be completed in accordance with applicable standards for industrial development, with particular emphasis on in-built noise attenuation for the Proposal's power island components, to protect the acoustic amenity of the built environment. The Proposal's gas turbines and exhaust stacks would be designed to achieve the required standards of air quality through emissions control technology and atmospheric dispersal of exhaust plumes, while minimising aviation hazard and the overall visual and landscape impact.
To promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants.	Design, construction and maintenance of Proposal components would be undertaken in accordance with applicable standards. Proposed habitable buildings (control room, administration building and workshop) are situated in the south-east of the Proposal Site away from operational equipment in the north-west and fuel storage in the north-east (refer Figure 2.1). A Preliminary Hazard Analysis (Section 10.1) demonstrates that the Proposal complies with the criteria of Hazardous Industry Planning Advisory Paper No. 4 – Risk Criteria for Land Use Safety Planning (NSW, 2011) in regards to the safety of adjacent properties.
To promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State.	The Proposal has been declared to be critical State significant infrastructure and is therefore assessed under Division 5.2 of the EP&A Act. While consultation with local government is a key element of the stakeholder engagement strategy for the Proposal, Cessnock City Council has no statutory authority in the assessment or determination of State significant infrastructure. The Proposal has been assessed in this EIS with consideration for relevant State and Local environmental planning instruments and the EIS has been prepared to respond to applicable environmental planning legislation and agency comments.
To provide increased opportunity for community participation in environmental planning and assessment.	The Proposal's development process involved consultation with relevant stakeholders. Consultation undertaken is outlined in Chapter 5. The EIS will be exhibited and any submissions received will be responded to and considered by the Minister for Planning and Public Spaces in determining the development application.

23.3 Ecologically Sustainable Development

The principles of ecologically sustainable development, as defined in Clause 7 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000, and how they have been considered during the design and assessment of the Proposal, are outlined below. This section shows that the Proposal is fully justifiable on the basis that it addresses each of the principles of ESD.

23.3.1 The precautionary principle

This principle states: 'if there are threats of serious or irreversible damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation'.

No threats of serious or irreversible damage have been identified, nor are considered likely as a result of the Proposal. Nor have any environmental safeguards or mitigation measures been postponed due to a lack of scientific certainty.

Consistent with the precautionary principle, the environmental assessment of the Proposal has sought to minimise environmental impact through the avoidance of impacts and a range of mitigation measures are proposed to address identified residual impacts. These measures will be implemented either during the Proposal's construction or operation.

23.3.2 Intergenerational equity

The principle states: 'the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations'.

The Proposal is not considered to sterilise land to any significant extent with almost all components of the Proposal to be located in previously disturbed areas.

The objective of the Proposal is to provide dispatchable capacity and other services into the National Energy Market, to meet demand when the needs of electricity consumers are highest. Gas fired generation capacity provides firming of renewable generation projects' intermittent electricity supply to the NEM. Without dispatchable and firming generation or storage, a power system that is solely reliant on intermittent renewable generation will have unacceptable levels of customer supply failure. Therefore, the Proposal is an important component in the long term transition to renewable energy by facilitating the displacement of carbon based electricity generation, which will contribute to maintaining and enhancing the health, diversity and productivity of the environment for the benefit of future generations.

23.3.3 Conservation of biological diversity and ecological integrity

This principle states: 'the diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival'.

No significant impact on threatened species or communities has been identified or predicted. Biodiversity impacts have been reduced by site selection and reuse of former industrial land, and biodiversity credits would be offset in accordance with the BC Act resulting in a neutral or beneficial biodiversity outcome.

23.3.4 Improved valuation, pricing and incentive mechanism

This principle is defined as:

Improved valuation, pricing and incentive mechanisms, namely, that environmental factors should be included in the valuation of assets and services, such as:

i. polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,

ii. *the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,*

iii. *environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.*

The following are examples of how environmental factors are included in the valuation of the Proposal:

i. The cost of compliance with applicable environmental regulations, such as meeting the *Protection of the Environment Operations (Clean Air) Regulation 2010* emission limits by designing and implementing emission control technologies as part of the Proposal, and implementation of an Operational Environmental Management Plan to meet the conditions of any Environmental Protection Licence (EPL) issued by NSW EPA, will be borne by Snowy Hydro.

ii. Construction, operation, decommissioning and remediation costs of the Proposal will be recovered in the pricing of electricity generated by the Proposal and paid by electricity users.

iii. Biodiversity credits would be offset in accordance with the NSW Biodiversity Offsets Scheme (BOS) resulting in a neutral or beneficial biodiversity outcome. The BOS is a framework to avoid, minimise and offset impacts on biodiversity from development and clearing, and to ensure land that is used to offset impacts is secured in-perpetuity. Biodiversity credits are generated from management actions that improve biodiversity values and are used to offset the loss of biodiversity values on development sites.

23.4 Summary and conclusion

The proposed Hunter Power Project and associated infrastructure represents an approximately $610 million investment by Snowy Hydro to assist in securing reliable, dispatchable electricity supplies for the national electricity market over the long term.

The choice of the site for the Proposal was based on due diligence surveys of all practical options and a decision based on the preferred option having the ability to reuse former industrial land, utilise existing infrastructure to the Proposal Site, a relatively low overall cost, and good environmental and social outcomes compared with the other options. Redevelopment of the Proposal Site for power station use is consistent with the former and planned future land use in the area and will not preclude or affect future land uses in the area.

Key environmental issues were considered and potential impacts on those issues assessed. With the implementation of appropriate mitigation measures the residual impacts of the project would be low, and there is no environmental reason why the project should not proceed in the form described within this Environmental Assessment report.

This EIS provides a description of the Proposal, existing information on environmental context and potential for environmental impacts. This EIS has been prepared to address the SEARs issued by the NSW DPIE on 5 February 2021 and focuses on key issues of noise, air quality, biodiversity, traffic, hazards and risk (including aviation hazard and plume rise), and socio-economic impacts. Based on the findings of the EIS, the Proposal is considered suitable for approval by the Minister for Planning and Public Spaces. The overall Proposal benefits including dispatchable electricity and other network services are considered to outweigh the environmental and limited social impacts.

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25. Appendices

Appendix A. Secretary’s Environmental Assessment Requirements

Appendix B. Biodiversity Development Assessment Report

Appendix C. Aboriginal Cultural Heritage Assessment Report

Appendix D. Statement of Heritage Impacts

Appendix E. Hazard and Risk Assessment

Appendix F. Bushfire Assessment Report

Appendix G. Aeronautical Impact & Risk Assessment of the Plume Rise

Appendix H. Groundwater Impact Assessment

Appendix I. Surface Water Quality and Aquatic Ecology Impact Assessment

Appendix J. Hydrology and Flooding Assessment

Appendix K. Air quality impact assessment report and greenhouse gas assessment

Appendix L. Noise and vibration impact assessment report

Appendix M. Traffic and transport assessment report

Appendix N. Landscape character and visual impact assessment report