



VIRTUSHERITAGE



Menz Solar Farm
962 Black Gully Road
Werris Creek, NSW

DUE DILIGENCE ABORIGINAL ARCHAEOLOGICAL ASSESSMENT

FINAL ♦ October 2020

Prepared for KDC

Version	Date	Prepared by	Approved by	Comments
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All queries related to the content, or to any use of this report must be addressed to Dr Mary-Jean Sutton.

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EXECUTIVE SUMMARY

Virtus Heritage was engaged by KDC on behalf of Wynergy Pty Ltd to prepare an Aboriginal archaeological due diligence assessment for the Menz Solar Farm Project. The project is located at Lot 1 DP 509915, 962 Black Gully Road, Werris Creek, NSW. It is within the Liverpool Plains Shire Council local government area (LGA). The proposed project is for the development of a solar grid-connected PV farm including an approximately 5MW installation, a proposed permanent access road, a proposed new power pole, an aerial cable from power pole to 'T' connection with 11kv feeder and an 11kv underground cable to follow the proposed road.

Consultation

The project area lies within the boundaries of the Nungaroo Local Aboriginal Land Council (LALC). Mr. David Horton, Sites Officer, Nungaroo LALC attended the site survey to assist with identifying Aboriginal sites and objects and provide cultural information about the project area. Comments made during fieldwork were recorded (refer to **Section 5**). A copy of the draft report was provided to the LALC for review and comment on 9th October 2020 (refer to **Appendix A**). No comments were provided by Nungaroo LALC.

Environmental Context

The project area is connected to a major creekline (Werris Creek) that is characteristic of the area, on low relief floodplains and gently inclined footslopes across an undulating meander plain. It is part of the Nandewar Bioregion and Namoi Catchment subregion, which encompasses the nearby towns of both Quirindi and Gunnedah. The nearest permanent major water source is the Mooki River, which lies 22.5km to the west of the project area. Werris Creek falls within the basin of the Mooki River and would have been a major creek fed by the permanent waterway, which also feeds all major creeks in the vicinity (GSS Environmental 2010: 7-13).

European land use impacts in the region include mining and vegetation clearing for farming activity, however prior to these impacts the project area and surrounding region would have provided Aboriginal people with diverse resources including stone raw material, and floral and faunal resources including aquatic resources from the creeks and waterholes. Despite harsh winters in the region these resources were utilised year-round by Aboriginal people. While the immediate area around the proposed site has not been disturbed by large scale mining activities, the area has been stripped of vegetation for cattle grazing and cultivation. Erosion due to the lack of protective native woodland and thus soil retention may have affected the preservation of Aboriginal sites and material evidence of occupation in this otherwise resource abundant landscape.

Archaeological Context

The results of background archaeological research, including heritage searches and a review of previous archaeological assessments in the region, indicate that the most common site types in the region are artefact sites, followed by grinding grooves and scarred trees. Despite heritage register searches indicating that no sites have been recorded in the project area or immediate vicinity there is a rich and varied archaeological record for the region across different landforms. Site types in the broader region include rock art sites, camp sites, open artefact scatters, scarred or carved trees for ceremonial and utilitarian purposes, grinding grooves for sharpening tools, quarry locations at sources of raw material, ceremonial rings in flat, exposed basalt and granite outcrops, burials, hearth sites, and shell middens in proximity to water sources.

Site Inspection Results

The site inspection was undertaken on the 28th August 2020 within lands in the Nungaroo LALC area. The site inspection was undertaken by Jac Carr, Senior Archaeologist, Virtus Heritage and Mr David Horton

over a half field day. The proposal area was surveyed by pedestrian targeted survey. All areas of exposure, mature trees and drainage lines were inspected. No Aboriginal sites or objects were located in the project area during the site inspection (refer to **Section 5**).

Recommendations

The following recommendations have been made based on the information provided on project impacts, consultation to date, relevant archaeological and environmental background research, and the results of the site inspection.

- 1) No Aboriginal objects were identified during the site inspection. No Aboriginal places are registered within the project area. No areas of archaeological potential are identified within the project area requiring archaeological testing, salvage or mitigation
- 2) During the survey, Mr Horton commented that he would like monitoring to occur when ground disturbance works occur. KDC may consider the request, however cultural collection can only occur legally in consultation with the DPC Heritage NSW and relevant Aboriginal stakeholder groups as conditioned within an AHIP.
- 3) All site workers and personnel involved in site impact works associated with the proposal site should be inducted and briefed on the possible identification of Aboriginal sites and objects during construction and their responsibilities according to the provisions of the *NPW Act, 1974*, in case any unknown objects or items are uncovered during excavation.
 - a. As part of this induction, the contact telephone numbers of the DPC Heritage NSW regional archaeologist and EnviroLine 131 555, the relevant DPIE Environmental Officer responsible for this project should also be given to all site workers and personnel, in case unknown objects or items are uncovered during excavation.
 - b. Site workers should be made aware of Aboriginal objects and site types and their scientific and cultural significance and their legal obligations in relation to the protection and management of these Aboriginal sites under the NPW Act, 1974 and 2010 ancillary provisions and amendments.
 - c. As part of this induction, workers should be made aware that in the event that any suspected human remains are uncovered on site, the area of these suspected remains should be secured and cordoned off and the NSW Police notified. No further works can be undertaken until the NSW Police provide written advice. If these remains are deemed to require archaeological investigation by the NSW Police or NSW Coroner, then OEH, the relevant Aboriginal parties must be notified. A plan of management for the preservation of any identified Aboriginal human remains or for their salvage must be put in place or conducted under a revised AHIP methodology and variation developed in consultation with all relevant Aboriginal parties and the DPIE.
 - d. During the survey, Mr Horton commented that he would like a cultural heritage induction be given to all site workers. KDC or the delegated authority may wish to consider the input and engagement of interested Aboriginal stakeholder groups and Nungaroo LALC in the development of inductions and tool box talks for this project.

1. INTRODUCTION

Virtus Heritage was engaged by KDC on behalf of Wynergy Pty Ltd to prepare an Aboriginal archaeological due diligence assessment for the Menz Solar Farm Project. The project is located at Lot 1 DP 509915, 962 Black Gully Road, Werris Creek, NSW. It is within the Liverpool Plains Shire Council Local Government Area (LGA) (refer to **Figure 1**).

1.1 Project Description

The proposed solar grid-connected PV farm at Werris Creek will include an approximately 5MW installation with a proposed permanent access road, a proposed new power pole, an aerial cable from power pole to 'T' connection with 11kv feeder and an 11kv underground cable to follow the proposed road (refer to **Figure 2**).

1.2 Report Aims and Statutory Requirements

This report was compiled with reference to the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (DECCW 2010a) and where applicable, the requirements of the *Code of Practice for Archaeological Investigation of Aboriginal Objects, NSW* (hereafter referred to as the 'Code of Practice') (DECCW 2010b). The purpose of this report is to provide advice on Aboriginal archaeological (scientific) values of the project area in relation to the proposed works to guide the client in its decision making process.

In general, the aims of a due diligence assessment are to:

- identify whether or not Aboriginal objects are, or are likely to be, present in the area;
- if objects are present or likely to be present, determine whether the proposed development activities are likely to harm Aboriginal objects; and
- determine whether further assessment or an Aboriginal Heritage Impact Permit (AHIP) is required.

The *National Parks and Wildlife Act 1974* (NPW Act), the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Heritage Act, 1977* are the relevant statutory controls protecting Aboriginal heritage within New South Wales.

1.2.1 National Parks and Wildlife Act 1974

Under the provisions of the NPW Act, all Aboriginal objects are protected regardless of their significance or land tenure. Aboriginal objects are defined as '*any deposit, object or material evidence (not being a handicraft made for sale) relating to Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with the occupation of that area by persons of non-Aboriginal extraction and includes Aboriginal remains*'.

Aboriginal objects are therefore limited to physical evidence and may also be referred to as 'Aboriginal sites', 'relics' or 'cultural material'. Aboriginal objects can include pre-contact features such as scarred trees, middens and artefact scatters, as well as physical evidence of post-contact use of the area such as Aboriginal built fencing or stockyards and missions.

The NPW Act also protects Aboriginal Places, which are defined as '*a place that is or was of special significance to Aboriginal culture. It may or may not contain Aboriginal objects*'. Aboriginal Places can only be declared by the Minister administering the NPW Act. The NPW Act protects Aboriginal objects and Aboriginal places in NSW. Under the *National Parks and Wildlife Act 1974* (NPW Act), including the

2010 amendments, it is an offence to harm an Aboriginal object:

- Which the person knows is an Aboriginal object (a ‘knowing offence’)
- Whether or not a person knows it is an Aboriginal object (a ‘strict liability offence’).

At 1 October 2010, the maximum penalty for a knowing offence is \$550,000 for an individual or \$1.1 million for a corporation and a 2-year gaol term. The maximum penalty for a strict liability offence is \$110,000 for an individual or \$220,000 for a corporation (DECCW 2010b:5). A person or organisation who exercises due diligence in determining that their actions would not harm Aboriginal objects has a defence against prosecution for the strict liability offence if they later unknowingly harm an object without an AHIP (DECCW 2010b, 2010:5). The due diligence defence is not available for activities which harm Aboriginal places. The Code of Practice sets out a procedure which, when followed, will satisfy the due diligence requirement. If a person or company can demonstrate that they exercised due diligence and determined that it was unlikely that Aboriginal objects would be harmed, then they have a defence to prosecution under the strict liability offence under Section 86(2) of the NPW Act (DECCW 2010b 2010:5).

Harm includes activities that destroy, deface or damage an Aboriginal object or Aboriginal Place, and in relation to an object; move the object from the land on which it has been situated. Under Section 91 of the Act, the Department of Premier and Cabinet (DPC) Heritage NSW must be informed upon the identification of all Aboriginal Objects. Failure to do this within reasonable time is an offence under the Act. Under Section 90 of the Act, it is an offence for a person to destroy, deface, damage or desecrate an Aboriginal Object or Aboriginal Place without the prior issue of Section 90 consent. Section 90 consents may only be obtained from DPC Heritage NSW. Part 6 of the NPW Act provides specific protection for Aboriginal objects and places by making it an offence to harm them. If harm to Aboriginal objects and places is anticipated an Aboriginal Heritage Impact Permit (AHIP) is required.

The Act also provides for stop-work orders under Section 91A if an action is likely to significantly affect an Aboriginal object or Aboriginal Place. The order may require that an action is to cease or that no action is carried out in the vicinity of the Aboriginal object or Aboriginal Place for a period of up to 40 days.

1.2.2 *Heritage Act, 1977*

The *Heritage Act, 1977* (as amended in 2009) protects and aims to conserve the environmental heritage of New South Wales. *Environmental heritage* is broadly defined under Section 4 of the *Heritage Act* as consisting of “those places, buildings, works, relics, moveable objects, and precincts, of State or local heritage significance” (Heritage Branch, DoP 2009:4). Aboriginal places or objects that are recognized as having high cultural value (potentially of local and State significance) can be listed on the State Heritage Register and protected under the provisions of the *Heritage Act*.

Amendments to the *Heritage Act* made in 2009 have changed the definition of an archaeological ‘relic’ under the Act, so that it is no longer based on age. A relic is now an archaeological deposit, resource or feature that has *heritage significance* at a local or State level. This significance based approach to identifying ‘relics’ is consistent with the way other heritage items such as buildings, works, precincts or landscapes are identified and managed in NSW (Heritage Branch, DoP 2009:1). Section 4(1) of the *Heritage Act* (as amended 2009) defines ‘relic’ as follows:

Relic means any deposit, artefact, object or material evidence that:
(a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and
(b) is of State or local heritage significance (Heritage Branch, DoP, 2009:6).

Other relevant State and Commonwealth legislation are discussed below.

1.2.3 Environmental Planning and Assessment Act 1979

The EP&A Act requires that consideration be given to environmental impacts as part of the land use planning process. In NSW, environmental impacts include cultural heritage impacts. Part 3 of the Act relates to planning instruments including those at local and regional levels, Part 4 of the Act controls development assessment processes and Part 5 of the Act refers to approvals by determining authorities.

1.2.4 Native Title legislation

The Native Title Act 1993 (NTA) provides the legislative framework to:

- recognise and protect native title
- establish ways in which future dealings affecting native title may proceed and to set standards for those dealings, including providing certain procedural rights for registered native title claimants and native title holders in relation to acts which affect native title
- establish a mechanism for determining claims to native title
- provide for, or permit, the validation of past acts invalidated because of the existence of native title.

The *NSW Native Title Act 1994* was introduced to make sure the laws of NSW are consistent with the Commonwealth's NTA on future dealings. It validates past and intermediate acts that may have been invalidated because of the existence of native title.

The National Native Title Tribunal has a number of functions under the NTA, including maintaining the Register of Native Title Claims, the National Native Title Register and the Register of Indigenous Land Use Agreements and mediating native title claims.

1.2.5 Other Acts

The Australian Government *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* may be relevant if any item of Aboriginal heritage significance to an Aboriginal community or historical heritage is under threat of injury or desecration and state-based processes are unable to protect it. The *Environment Protection and Biodiversity Conservation Act 1999* is relevant to projects where there are heritage values of national significance present.

1.3 Consultation

Aboriginal people are the primary determinants of their culture and heritage, and cultural values can only be assessed and advised by the relevant Aboriginal parties for the locality. It should be noted that Aboriginal heritage refers both to Aboriginal archaeological sites and sites/places of cultural value to Aboriginal people, protected under the *National Parks and Wildlife Act, 1974* (NPW Act, 1974) as “Aboriginal Objects” and “Aboriginal Places”. Sites and places of Aboriginal cultural significance can only be identified by the relevant local Aboriginal people and are likely in many cases (for example, song lines and story places) to not contain any archaeological evidence.

This assessment was conducted by an archaeologist providing advice on the archaeological (scientific) values of the project area. The cultural values of the project area were assessed by the Nungaroo Local Aboriginal Land Council (LALC).

A copy of this draft report was provided to the LALC for review and comment on 9th October 2020 (refer to **Appendix A**). No comments were provided by Nungaroo LALC.

1.4 Limitations

This report is limited to the assessment of project impacts described in information provided by KDC on behalf of Wynergy Pty Ltd and mapped in this report. Virtus Heritage takes no responsibility for errors within Department of Premier and Cabinet, Heritage NSW Aboriginal Heritage Information Management Systems (AHIMS) data, and the heritage register listings and has assumed information provided by Department of Premier and Cabinet is accurate.

The site inspections undertaken were confined to areas of proposed works illustrated in **Figure 1** and **Figure 2**.

1.5 Project Team and Qualifications

This report was compiled by Elaine Lin (M.Arch.Sci. (Adv) Hons, Australian National University; B.Arts Hons. Archaeology, University of Sydney) with assistance from James Carr (B.Arts Hons. Archaeology, Monash University) with quality review undertaken by Dr Mary-Jean Sutton (Principal Archaeologist, PhD, Archaeology, University of Queensland; B.Arts Hon.s Prehistoric and Historical Archaeology, University of Sydney, MEIANZ). Project information and description of works was provided by KDC and Wynergy Pty Ltd.

1.6 Acknowledgements

We would like to acknowledge the assistance of the following individuals for the completion of this report:

- David Horton, Sites Officer, Nungaroo Local Aboriginal Land Council; and
- Kale Langford, Environmental Planner KDC



Figure 1
Locality Plan and Project Area

Legend

- Major Towns/Cities
- Locality
- Werris Creek
- Roads

- Proposed Works
- Solar Farm Area
 - Essential Energy 66kv Sub-Transmission and Easement
 - Transformers, Inverters, Metering and Storage
 - Riparian Zone and Ridgeline Aesthetic Screening
 - Proposed Permanent Access Road

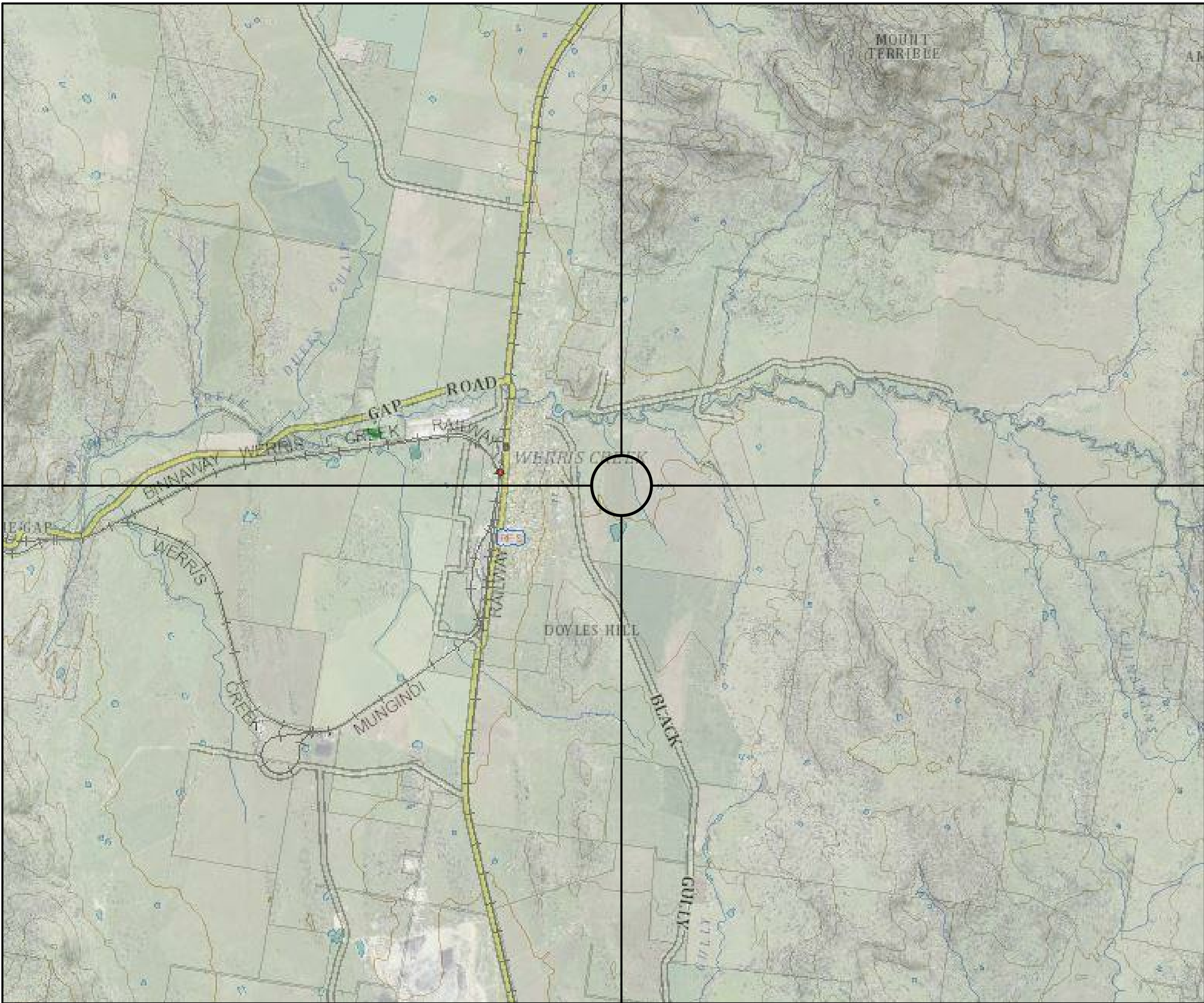


Source: NSW Spatial Services, AHIMS, Wynergy PTY LTD
Projection: GDA94
Maps and figures contained within this document may be based on third party data, may not be to scale and are intended for use as a guide only. Virtus Heritage does not warrant the accuracy of such maps or figures.



PROPOSED 4.995MWAC / 5.2MWAC AGRIVOLTAIC SOLAR FARM

LOT 1 DP 509915 BLACK GULLY ROAD WERRIS GREEK NSW 2341



Sheet List					
Sheet Number	Sheet Name	Current Revision	Current Revision Description	Current Revision Date	Drawn By
A01	COVER SHEET	5	DA APPLICATION	21/09/20	DKL
A02	SITE PLAN	5	DA APPLICATION	21/09/20	DKL
A04	TRACKER LAYOUT PLAN	5	DA APPLICATION	21/09/20	DKL

- GENERAL NOTES:**
- ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SHOWN.
 - WORK TO FIGURED DIMENSIONS, DO NOT SCALE FROM DRAWINGS.
 - CHECK ALL DIMENSIONS ONSITE PRIOR TO CONSTRUCTION.
 - REPORT ANY DISCREPANCIES TO OWNER.
 - DRAWINGS TO BE READ IN CONJUNCTION WITH THE SPECIFICATION, ENGINEER'S DRAWINGS, AND ALL CONSULTANT INFORMATION. REPORT ANY DISCREPANCIES TO OWNER.
 - ALL WORK ON BUSH FIRE PRONE LAND TO BE CONSTRUCTED IN ACCORDANCE WITH BUSH FIRE CONSULTANTS REPORT, AS3959 AND ITS AMMENDMENTS, THE NCC (BCA) AND GOVERNMENT REQUIREMENTS
 - ALL WORK TO BE CONSTRUCTED IN ACCORDANCE WITH THE CONDITIONS OF CONSENT AS DETERMINED BY THE APPROVING AUTHORITY
 - DETAILS AND DRAWINGS BY D LAWLESS COMMUNICATE 'DESIGN INTENT' ONLY. IT IS THE RESPONSIBILITY OF THE BUILDER TO ENSURE STRUCTURAL/TECHNICAL ADEQUACY WITH EXISTING STRUCTURE ON SITE, COMPATIBILITY WITH SELECTED COMPONENTS/MATERIALSAND ENGINEERS SPECIFICATION
 - ALL FLASHINGS, CAPPINGS, TERMITE TREATMENT, WATERPROOFING TO BE INSTALLED INACCORDANCE WITH AUSTRALIAN STANDARDS AND BCA REQ'S AS PER THE SPECIFICATION
 - ALL STRUCTURAL ELEMENTS SHOWN IN ARCHITECTURAL DRAWINGS ARE FOR GRAPHIC REPRESENTATION ONLY. REFER STRUCTURAL ENGINEER'S DRAWINGS FOR DETAILS

DA APPLICATION

5	DA APPLICATION	21/09/20
4	MINOR REVISION	07/09/20
3	REVISED ACCESS ROAD	30/06/20
2	MINOR REVISION	26/06/20
1	CONCEPT	21/06/20
No.	Description	Date

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ALL BUILDING WORKS TO COMPLY WITH THE BUILDING CODE OF AUSTRALIA AND ALL RELEVANT AUSTRALIAN STANDARDS.

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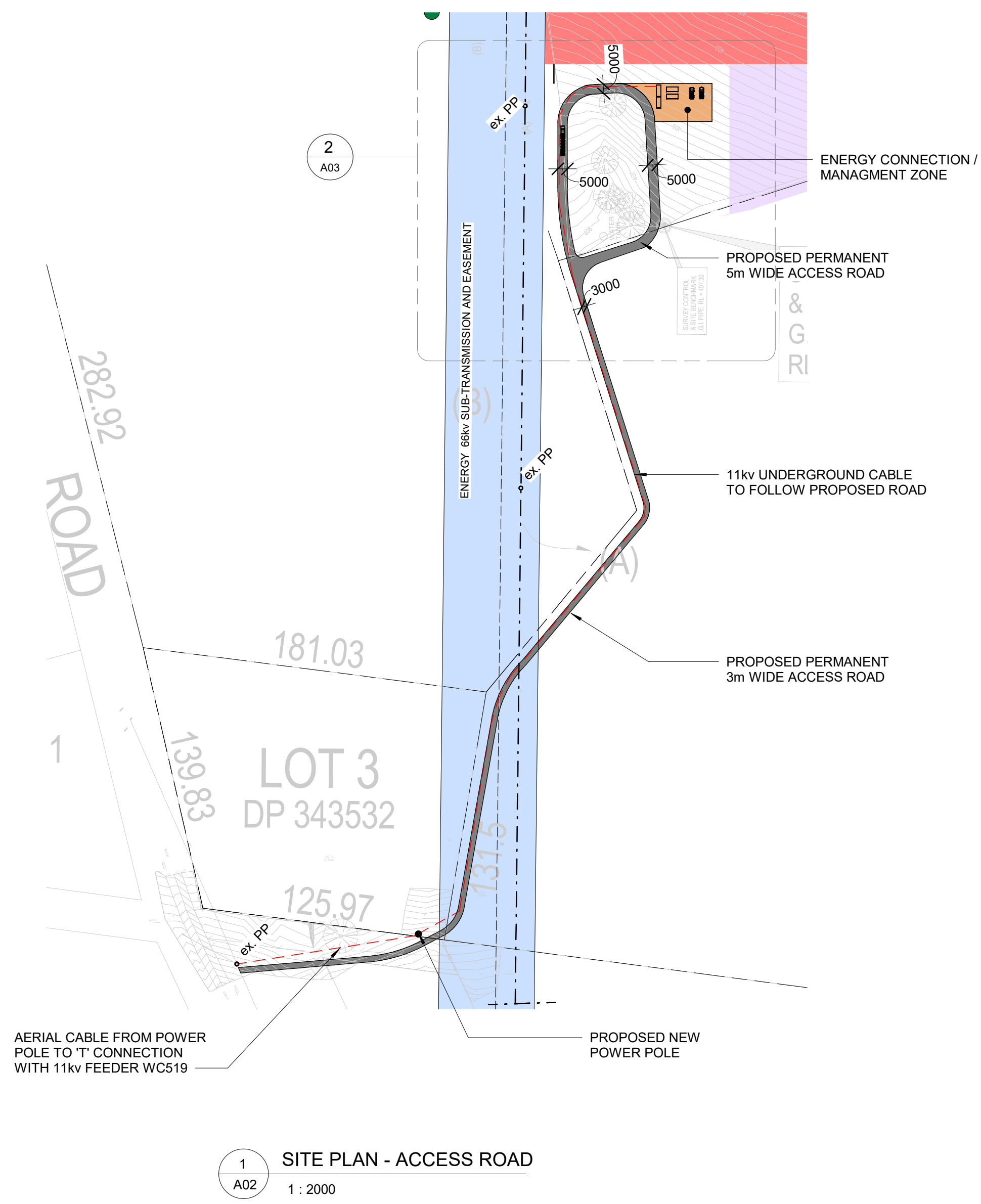
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COVER SHEET	
Project number	J250
Date	01-09-20
Drawn by	DKL
Scale	

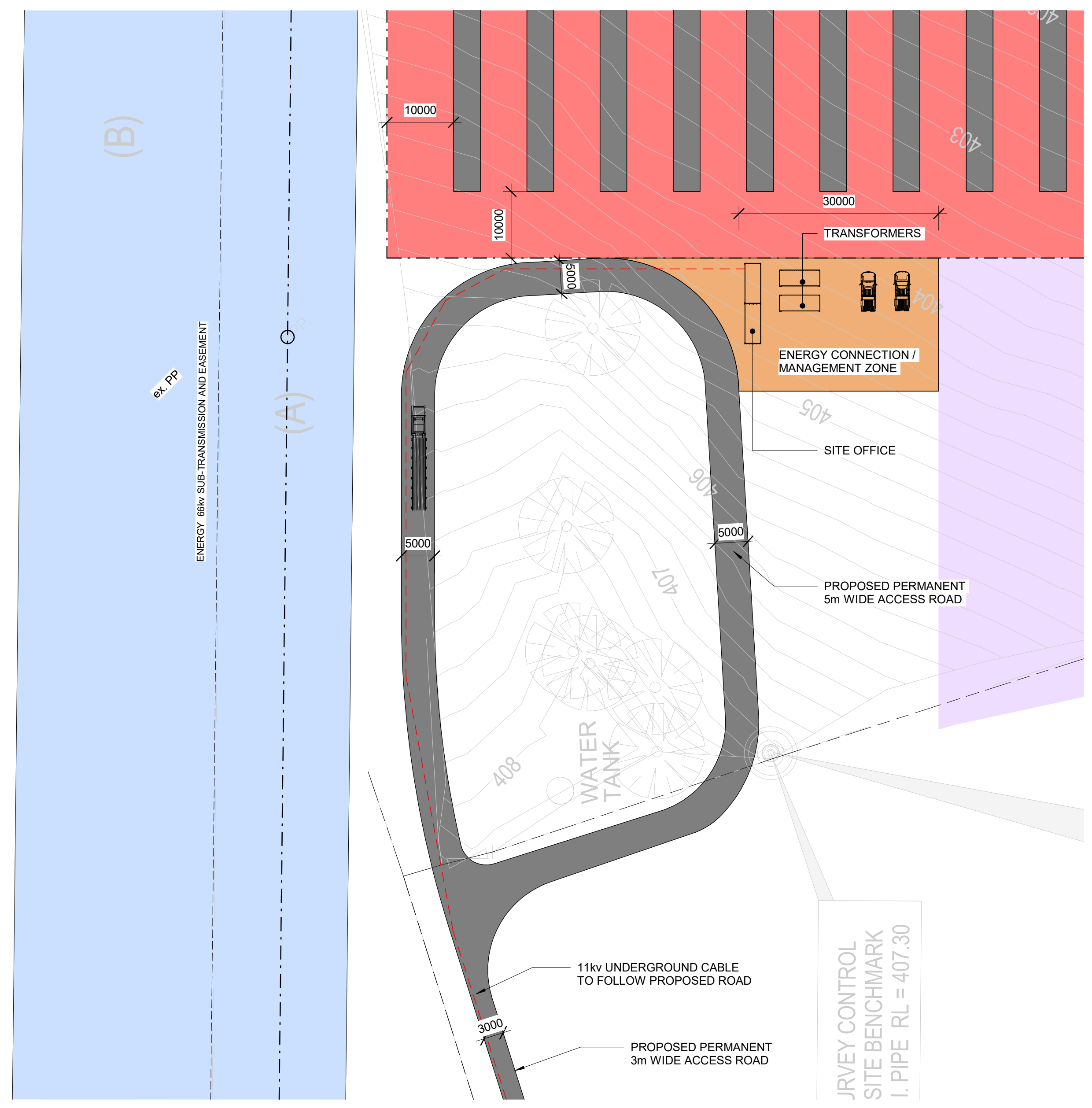
A01



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1 SITE PLAN - ACCESS ROAD
A02 1 : 2000



2 SITE PLAN - ENERGY CONNECTION MANAGEMENT ZONE
A03 1 : 500

- LEGEND**
- DENOTES RIPARIAN ZONE - 40m FROM TOP OF BANK
 - DENOTES ESSENTIAL ENERGY 66kv SUB-TRANSMISSION AND EASEMENT
 - DENOTES SOLAR FARM AREA
 - DENOTES ENERGY CONNECTION ZONE - TRANSFORMERS, INVERTERS, METERING AND STORAGE
 - STAGING AREA DURING CONSTRUCTION
 - RIDGELINE AESTHETIC SCREENING AND RIPARIAN BINDING (EROSION CONTROL) PLANTING: FAST TO MEDIUM GROWING, INDIGENOUS SPECIES INCLUDING ACAICA, MELALEUCA, CALLISTEMON, KURRAJONG AND EUCALYPTUS.

DA APPLICATION

3	DA APPLICATION	21/09/20
2	MINOR REVISION	07/09/20
1	REVISED ACCESS ROAD	30/06/20
No.	Description	Date

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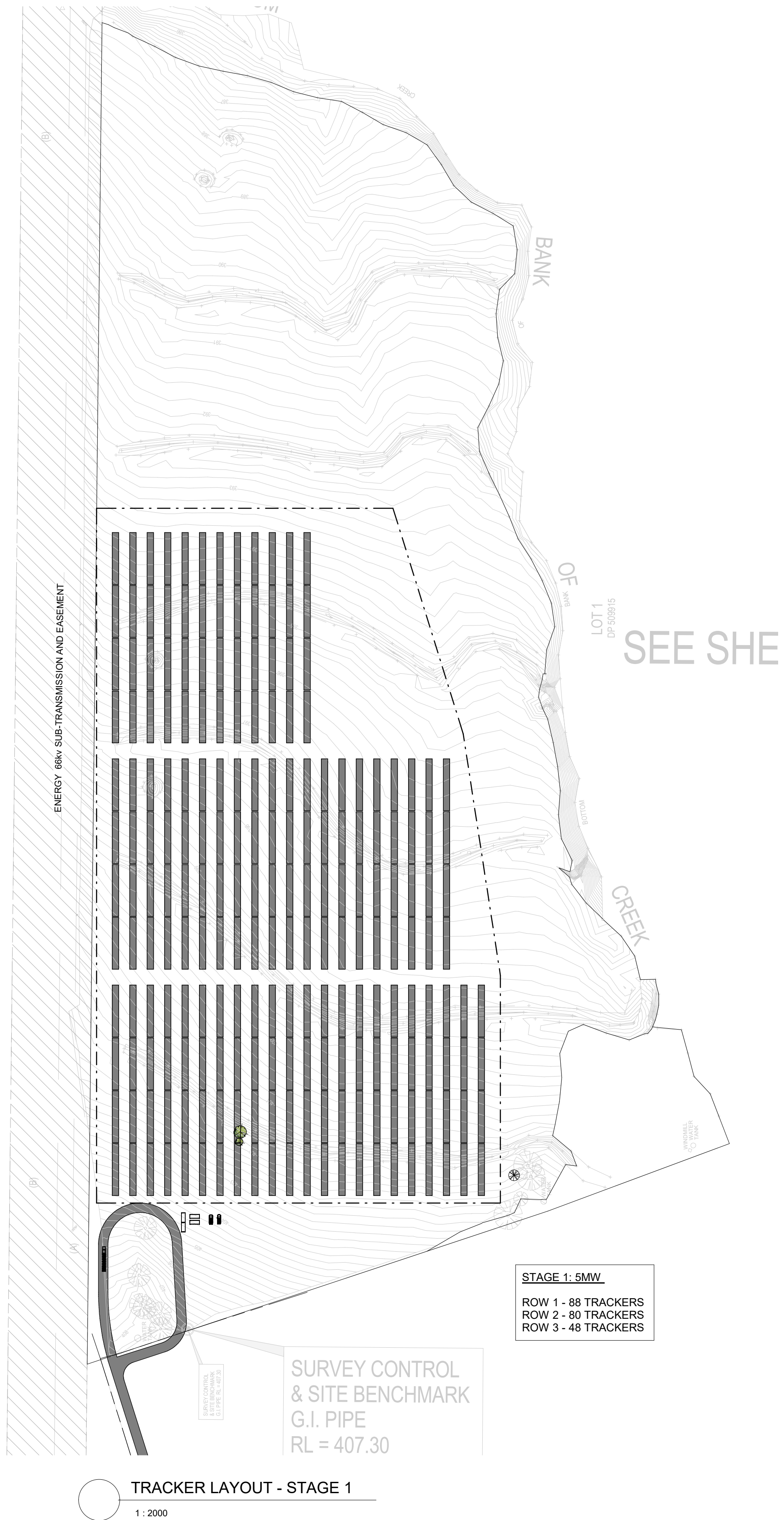
LOT 1 DP 509915
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SITE PART PLAN	
Project number	J250
Date	01-09-20
Drawn by	DKL
Scale	As indicated

A03

WYNERGY

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TRACKER LAYOUT - STAGE 1
1 : 2000

STAGE 1: 5MW
ROW 1 - 88 TRACKERS
ROW 2 - 80 TRACKERS
ROW 3 - 48 TRACKERS

SURVEY CONTROL
& SITE BENCHMARK
G.I. PIPE
RL = 407.30

DA APPLICATION

5	DA APPLICATION	21/09/20
4	MINOR REVISION	07/09/20
3	REVISED ACCESS ROAD	30/06/20
2	MINOR REVISION	26/06/20
1	CONCEPT	21/06/20
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BLACK GULLY ROAD
WERRIS GREEK NSW 2341

TRACKER LAYOUT PLAN	
Project number	J250
Date	01-09-20
Drawn by	DKL
Scale	1 : 2000

A04

WYNERGY

0 20000 40000 60000 80000 100000

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2. ENVIRONMENTAL CONTEXT

This section of the report describes the environmental context of the project area spanning previous land-use history, topography and landforms, soils and geology, and fauna and flora. These factors are integral influences of Aboriginal land use, the resultant patterning of archaeological sites, and the survival of sites in the modern landscape.

2.1 Previous Land Use History

John Oxley was the first European explorer to arrive in the region in 1818 (Oxley 1820). He named the land the Liverpool Plains, and in the same year named the Peel Valley and Peel River (named after Robert Peel, the Secretary of State for Ireland and later Prime Minister). Oxley described the Peel River as “the largest interior river we have seen except for the Macquarie and Castlereagh” (TRC 2006: 8). Graziers were firmly established in the area by the 1820’s (TRC 2006: 11). Cattle grazing was the dominant land use of the region in the early days of European settlement but by the end of the 1800s sheep grazing was expanded due to improved pastures and better fencing (NSW DPIE website, accessed August 2020).

The gold rush of the 1850s led to the rapid entrenchment of several towns in the region, while the burgeoning cattle industry in the Liverpool Plains enticed squatters and cattlemen to settle and pass through the major towns of the region. By 1876, the railway line was extended from Sydney through the Liverpool Range using the Great Northern Road as a route (Landscape 2010: 6 – 35). This Great Northern Line was installed approximately 800m west of the project area along the western boundary of the township. This line extended from Murrurundi to Tamworth, with Werris Creek set up as a town and junction to house the 500 rail workers constructing the line in 1877. The town of Werris Creek was the first settlement in NSW to have been developed exclusively for the construction and servicing of the railways (Ware 1976).

The mining of the area for various materials led to explorations of a plot on the eastern slopes of “Old Colliery” Hill, approximately 4km southwest of the project area. The Preston Iron Coal and Coke Mining Company Limited drilled to test two coal seams in 1924 and 1925, eventually being granted a coal mining lease in 1925 in the area which is now the modern Whitehaven Werris Creek Mine (Landscape 2010 6 – 35). The expansion of the industry led to the establishment of the Werris Creek Colliery Rail Branch, which came into operation in 1929 and increased production to approximately 20,000 tons of coal per annum (Andrews and Currey, unpublished manuscript).

While the proposal area itself has not been directly affected by the coal mining industries in Werris Creek, it has been heavily impacted by European settlement. These activities include grazing and more intensive agriculture. The Liverpool Plains area has had a long history of cropping since the early 20th century. Much of the original landscape had been subdivided into smaller, cleared blocks, where cereal crops were largely cultivated in perennial pastures with grazing, or increasingly in rotating pastures (Banks 2001: 33).

The project area is subject to heavy sheetwash and erosion due to this long history of cropping, and land degradation is highly likely to have impacted the retention of remnant or later topsoils in these rural plots. Though the intensive farming and ploughing of the paddocks in the project area may have disturbed intact Aboriginal sites and material indicators of Aboriginal cultural heritage, there remains moderate potential for deep soil profiles associated with the local geology types. These soil profiles have moderate potential for the occurrence of archaeological deposits and evidence for Aboriginal occupation of the area.

2.2 Topography, Hydrology and Climate

The proposed project area is situated directly east of the township of Werris Creek in line with its northern

extent, bounded by Werris Creek Stock Road (Black Gully Road) to the west and the creekline to the north. The area is approximately 33km southwest of the town of Tamworth, and approximately 16km north/northwest of the town of Quirindi. It is part of the Nandewar Bioregion and Namoi Catchment subregion, which encompasses the nearby towns of both Quirindi and Gunnedah.

The project area is situated within the Nandewar Bioregion, which is traversed by the Peel, Macdonald, MacIntyre, Namoi, Severn and Gwydir rivers. It is part of the broader Namoi catchment, which is bordered by the Great Dividing Range in the east, the Liverpool Ranges and Warrumbungle Ranges in the south, and the Nandewar Ranges and Mount Kaputar to the north (Brown 2020: 131). The nearest permanent major water source is the Mooki River, which lies 22.5km to the west of the project area. The Mooki River is a perennial stream that is within the Murray-Darling basin, meeting the Namoi River to the north of Werris Creek near the town of Gunnedah. Werris Creek falls within the basin of the Mooki River, and would have been a major creek fed by the permanent waterway, which also feeds all major creeks in the vicinity (GSS Environmental 2010: 7-13).

The Nandewar Bioregion has a mostly warm and dry sub-humid to temperate climate, though average annual temperatures and rainfall varies markedly across the bioregion in relation to elevation (NSW NPWS 2000). The lowlands and main river catchments around the project area would have been warmer due to the lower elevations. The average annual rainfall also varies in this manner, though is generally characterised by frequent rains of high intensity with high sediment run-off from the steep slopes into the catchment areas (Morgan and Terrey 1992).

Rainfall varies due to the differing topography across the bioregion, with areas at higher altitudes receiving significantly more rain annually than the lower lying areas (NSW NPWS 2000) such as the plains within which the project area is situated. The mean annual rainfall is 566 – 1270mm, while the mean annual temperature is 10 – 18°C (NSW DPIE website, accessed August 2020). The rainfall in the Nandewar Bioregion is prone to being summer dominant (Morgan and Terrey 1992).

The topography of the project area ranges from level floodplains and meander plains along the creekline, to very long and gentle footslopes surrounding some gently undulating to rolling hills in the centre of the site. These hills have rounded narrow crests and waning hummocky sideslopes. Some steeper hills occur to the north of Werris Creek and to the south of the project area, though not within the boundaries of the site itself. The local relief is no more than 200m.

2.3 Geology and Soils

The proposed site is situated in the Currububula Formation in the Werrie Block/Tamworth Belt, underlying Werries Basalts and Quaternary Alluvium. It is within the Gunnedah Basin, and is characterised by basaltic lavas, tuffs, autochthonous and cataclysmic sediments, and local thin coals (Geoscience Australia 2017: Stratigraphic Unit #19752; Manser 1965). The Werrie Basalt has been overlain by unconsolidated sediments of the Quaternary period (GSS Environmental 2010: 7-12).

Three soil landscape units underpin the project area as defined in the 'Soils of the Tamworth 1:100 000 Sheet Report (Banks 2001). The creekline to the north of the site is defined as an alluvial 'Currububula Creek' landscape, while a north-south oriented strip running through the centre of the project area is part of the erosional 'Dunover' soil landscape. The floodplain comprising most of the site is defined as part of the transferral soil landscape unit 'The Siphon'. The following **Table 1** summarises the primary characteristics of the three soil landscapes of the project area.

Table 1. Soil Landscape Group

SOIL LANDSCAPE GROUP	TOPOGRAPHY AND GEOLOGY	SOIL PROFILE TYPES
Currububula Creek	Level floodplains, meander plains, levees and backswamps with slopes ranging 0.2 – 2%. The landscape ranges 50 – 1000m in width, is long and sinuous, and generally drains from the eastern side of the Melville Ranges through to the eastern margins of the Liverpool Plains. Drainage is by continuous, alluvial, bedrock-controlled, sinuous unidirectional incised channels. The geology contains highly variable sands, silts, clays and gravels in Quaternary alluvium derived from the Carboniferous sedimentary rocks, metasediments and volcanics from the Melville Ranges.	Depth of alluvium generally ranges 5 – 20m and contains randomly distributed Black Vertosols, Grey Clays, Brown Chromosols, Brown Kandosols and very deep Brown Earths (Banks 2001: 188).
The Siphon	Very long and very gently to gently inclined footslopes on basic volcanic alluvium/colluvium with a local relief of less than 200m. The volcanic alluvium and colluvium soil profiles in the area derive from the Permian Werrie Basalts, which are very deeply weathered and highly fractured (Banks 2001: 167).	The common soil profiles of regions in this landscape unit include Red and Brown Chromosols, Red Ferrosols on upper footslopes, Black Vertosols on mid footslopes, and Grey Vertosols on lower footslopes (GSS Environmental 2010: 7-13).
Dunover	Undulating to rolling hills with rounded narrow crests and waning hummocky sideslopes with a local relief to 200m. The soil landscape unit is associated with a Lower Permian volcanic complex including the Warrigundi Inclusions and the Werrie Basalts, over which the project area lies. Soils are mostly formed on colluvium derived from these geologies.	Soil profiles common to the unit include Paralithic Leptic Rudosols, Black and Brown Chromosols on steeper upper and midslopes, Red and Brown Vertosols and some Black Vertosols in drainage depressions (Banks 2001: 81).

2.4 Flora and Fauna

Prior to European settlement and subsequent intensive agricultural land use, the area would have provided an abundance of floral and faunal resources for local Aboriginal people. In terms of vegetation, the Nandewar Peel Bioregion is characterised by white box grassy woodlands, with yellow box and Blakeley's red gum on the lower slopes. The plains and flat areas are occupied by rough-barked apple and yellow box,

while river oak and some river red gum occur along major streamlines. Steeper slopes in the east of the region are vegetated by patches of red stringybark and ironbark on the steeper slopes. On basalt caps, silver-leaved ironbark is prevalent, while stony areas in the west and north are vegetated by white cypress pine and kurrajong (Mitchell 2002: 77). Very large grass trees have also been noted on underlying serpentinite in the region (NSW DPIE website, accessed August 2020).

The vegetated slopes would have provided ample terrestrial resources. These would have included many species of birds, snakes, lizards, marsupials, honeyeaters, gliders, tortoises and arboreal mammals (NSW DPIE website, accessed August 2020). The box woodland would have been a suitable habitat for possums, koalas, snakes, bats, goannas, birds, native bees, as well as insects and grubs. The grasslands would have provided habitats for kangaroos, wallabies, echidnas, snakes, birds and insects. Additionally, the grassland areas around Werris Creek may have provided an abundance of seeds, nectar and bark (Archaeological Surveys and Reports Pty Ltd 2004: 6 – 15).

Though no wetlands exist in the immediate vicinity, the Mooki River and connecting creeks such as Werris Creek would have been a rich source of aquatic animals, including fish, fishing birds, and notably turtles (Cann and Ward 1998). While this region may have had high levels of biodiversity in the past, the current landscape has since been heavily cleared and extensively cultivated since European settlement. The flat areas and rolling hills would have been easy to traverse and the waterways and vegetated slopes abundant in resources. It is, however, unlikely that sites relating to resource collection and processing would have remained undisturbed in the heavily cultivated areas.

2.5 Summary

The project area is situated immediately south of Werris Creek, with access to another unnamed ephemeral creekline to the east. These creeklines are common to the area, with its low relief undulating plains allowing for drainage by continuous alluvial, bedrock-controlled, sinuous, unidirectional incised channels (Banks 2001: 188). This region is characterised by undulating and rolling hills and plains on Permian sedimentary rocks with extensive volcanic basalts (Banks 2001: 167).

European land use impacts in the broader region include mining and vegetation clearance for farming activity, however prior to these impacts the project area and surrounding region would have provided Aboriginal people with diverse resources including stone raw material, and floral and faunal resources including aquatic resources from the creeks and waterholes. Despite harsh winters in the region these resources were utilised year-round by Aboriginal people. While the immediate area around the proposed site has not been disturbed by large scale mining activities, a large open cut mine exists in the greater region (Whitehaven Coal Werris Creek Mine). The project area itself has been stripped of vegetation and heavily ploughed for cattle grazing and cultivation. Erosion due to the lack of protective native woodland and thus soil retention may have affected the preservation of Aboriginal sites and material evidence of occupation in this otherwise resource abundant landscape, though there is moderate potential for deep soil profiles and archaeological deposits to occur associated with the local geologies.

3. ARCHAEOLOGICAL CONTEXT AND ETHNOHISTORY

This section presents the ethnohistorical and archaeological context for the evaluation of the project area, specifically known archaeological sites identified by previous archaeological investigations, and the understanding of Aboriginal heritage developed by previous archaeological and heritage studies.

3.1 Ethnohistorical Context

This section provides a description of the Aboriginal heritage context as relevant to the proposal. The Aboriginal heritage context includes a summary of Aboriginal history within the locality and material evidence of Aboriginal land use. This ethno-historical context is drawn from review of accessible sources including:

- *Australian Dictionary of Biography*
- Regional studies such as *The Tamworth Aboriginal Archaeological Site Study* (Wilson and McAdam 2000)
- A review of primary sources including parish maps and newspaper articles
- Sources identified on the National Library of Australia's *Trove* database
- The Kamilaroi (A Nations Identity) website, accessed August 2020
- The NSW Department of Planning, Industry and Environment website, accessed August 2020
- Consultation with Aboriginal community organisations in the locality

Aboriginal History within the Locality and Land Use

This section presents a summary of the known history of Aboriginal occupation of the region surrounding the proposal area. Language groups and clan boundaries are frequently contested or subject to different versions of recording depending on the sources of information. Our knowledge of the pre-contact social organisation and behavioural patterns of Aboriginal people often comes from early non-Aboriginal historical records. The information is, therefore, subject to the historical and cultural biases of the recorders. It is also important to remember that at the time many of the observations were made, the lifestyles of Aboriginal communities may have already been significantly altered by the presence of non-Aboriginal settlement.

This section is not meant to be a definitive history of Aboriginal people in the locality of Werris Creek, rather it is provided to give some insight into the historical circumstances that have influenced Aboriginal people connected to the region over time. It also aims to provide an overview of Aboriginal land use and its implications for understanding the survival of Aboriginal sites and potential occupation deposits within the project area.

People, Places and Language

The Kamilaroi people had a presence in the New England area for many thousands of years. According to surveyor R. H. Mathews the boundaries of the Kamilaroi extended from Jerry's Plains in the Hunter River, north as far as Walgett, Mungindi and Boggabilla on the Barwon River and across the Queensland border, taking in the basins of the Namoi and Gwydir Rivers. Anthropologist Norman Tindale described the boundaries of the Kamilaroi in the Liverpool Plains region as extending from Murrurundi north along the Great Dividing Range, through the foothills of the Moonbi and Nandewar Ranges as far as the upper reaches of the Gwydir River, then along the Gwydir to about where Moree is today (Ferry 2001: 19). Tindale argued that Kamilaroi territory did not extend into Queensland. Tindale also questioned Mathews' inclusion

of Jerry's Plains in Kamilaroi territory, believing it belonged in part to the Wonnarua People and in part to the Geawagal People (Boileau 2007:7). Adjacent language groups in the region include Anaiwan (south of Inverell, west to Tingha, to Armidale and south of Uralla), the Weraera (Wirrayaraay) and the Kwaimbul in the north (NSW DPIE website, accessed August 2020).

The various Kamilaroi communities were loosely bound by a common language spoken in different dialects throughout the whole area. Attempts to record the Kamilaroi language were made as early as 1856, in a book written by missionary William Ridley (Trove Website, accessed August 2020). The Kamilaroi had a complex and elaborate social system, and an elaborate language known as Gamilaraay (TRC 2006: 5). Gamilaraay is broken down into two words with Gamil meaning 'no' and Araay meaning 'having' (Kamilaroi Website, accessed August 2020).

Within the Kamilaroi tribal group there were two major subdivisions. The 'Corbon Gamilaroi' or 'the people of the greater country of the Gamilaroi' were the major subgroup, with responsibility for the core country of the Gamilaroi, including the Liverpool Plains, the Peel River Valley and the valleys of the Namoi and Gwydir rivers. The territory of the 'Gammon Gamilaroi' or 'the people of the lesser country of the Gamilaroi' included the southern area from Murrurundi in a narrow finger south into the Hunter Valley (Boileau 2007: 7).

The Kamilaroi had close links with the Darkinjung, Wonnarua and Geawagal peoples of the Upper Hunter, in particular with the Geawagal. They formed alliances and maintained social relationships through large intertribal gatherings where groups exchanged marriage partners, goods, songs, stories and dances. There were also strong trading, ceremonial and resource sharing relationships between the Kamilaroi of the Nundle district and the Anaiwan people of the New England Tableland (Boileau 2007: 7). An example of trade was from stone quarries situated at locations such as Moore Creek to other parts of Kamilaroi lands where there was a paucity of stone suitable for axe heads, knives and spearheads (TRC 2006: 5).

The landscape has influenced the names of many of the local towns and stations which are named after Aboriginal words for aspects of the landscape, usually in association with water or resources. 'Bingara' – creek or shallow crossing, 'Barraba' – camp by the riverbank, 'Manilla – muneela' – winding river, 'Quirindi – guyerwarindi' – waters fall together (NSW DPIE website, accessed August 2020). Other noted examples include 'Barwon' – wide or winding river; 'Biligha' (Pilliga) – place to go to obtain wood for spears; 'Calala' or 'Caloola' (or 'Killala' or 'Kalahlar') – place of battle or of winding river (name given to the section of the Peel River near Tamworth); 'Coopolly' (Quipolly) – waterholes containing fish; 'Daruka' – rocky mountain; 'Duri' – snake crawling through grass or water weed; 'Goonoo Goonoo' or 'Guna' – a term literally meaning 'dung heap' in the context of reference to the laxative qualities of running water over rocks in time of drought; 'Kootingal' – star; 'Manilla' (Manellae) – winding river, particularly the section that is almost circular; 'Moonbi' – ashes or pigeon; 'Moree' – spring or water hole; 'Murrurundi' (formerly 'Murrurundooranai') – five fingers (early white settlers claimed there was a feature resembling this shape in the area); 'Namoi' – species of acacia or curving river; 'Niangala' – eclipse of the moon; 'Tangaratta' (formerly 'Tangara') – pelican journeys or water rat; 'Wallabadah' – place of stones, snakes or young kangaroos; 'Warrah' – falling rain (TRC 2006: 5).

In 1842 Edward Mayne, first Commissioner of Crown Lands and Protector of Aborigines for the Liverpool Plains, estimated that there were about 4,000 Aboriginal people living between the Peel, Namoi and Gwydir Rivers. Considering the impact of over a decade of white settlement in the district, the Kamilaroi would have numbered far greater than the 4,000 estimated by Mayne in pre-contact times. The earliest dates for human occupation in the region are 4,950 BP from Bendemeer rock shelter on Glendon Station and 3,600 BP from Moore Creek 4 rock shelter (Boileau 2007: 8).

Kamilaroi were a matrilineal society, and children inherited their moiety and their totemic affiliation through their mother. The two moieties of the Kamilaroi were *Kupathin* and *Dilbai*. In 1866 missionary William Ridley recorded the totems of these moieties. The totems of the Kupathin were kangaroo, possum, bandicoot, black duck, pademelon, eaglehawk, scrub turkey, yellow fish, honey fish and bream. Those of the Dilbai were emu, carpet snake, black snake, red kangaroo, wallaroo, frog, goanna and cod fish (Boileau 2007: 8)

Land Use and Activity

A large variety of sites containing physical evidence of past Aboriginal land use remain within the local region. Site types include bora grounds/ceremonial grounds, grinding grooves, burials, cultural places, story places, campsites, artefact scatters, isolated finds, scarred and carved trees. As well as physical remains of past activity, the memories of local people, oral histories handed down, and early accounts of early non-Aboriginal people coming to the region can help to build up a picture of land use and the range of activities carried out in the past.

Aboriginal subsistence activities were likely seasonal and varied based on resource availability and social customs. Evidence of 'transient campsites' (noted by Mitchell as being distributed among the casuarinas and acacias) suggested a seasonal approach to hunting and gathering activities. Each group occupied defined hunting grounds within the territory, with boundaries being marked by watercourses, trees, and other recognised landmarks. (NSW DPIE website, accessed August 2020).

The Kamilaroi utilised a wide variety of plant and animal foods seasonally available in the rich riverine environment of the Namoi, Gwydir and Barwon river systems and in the ranges. The men hunted larger animals such as kangaroos and emus as well as smaller mammals, with stone and wooden hunting tools such as jagged spears, boomerangs and waddies developed to catch them. The women and children gathered grass seeds and other plant foods such as tubers, yams, berries, and fruit, and collected bird and reptile eggs. They also collected shellfish, trapped fish using stone weirs and nets made from plant fibre and hunted reptiles, small mammals and birds. Exploiting the widespread natural grasslands in their region, the Kamilaroi depended upon grass seeds for a major part of their subsistence. The seeds were ground and baked into small loaves (Boileau 2007: 8; NSW DPIE website, accessed August 2020). Watering holes and rivers (such as the Mooki River) were valuable tributaries for providing food, water and shelter. Local wood varieties (such as Myall wood) were used for trading purposes (Kamilaroi Website, accessed August 2020).

The Kamilaroi utilised natural resources to manufacture tools and artefacts: grasses and reeds for making baskets and nets for trapping fish, birds and small mammals; stone for manufacturing axes, spearheads and grindstones; wood and resins for manufacturing digging sticks, spears, boomerangs and other weapons. At times when resources were seasonally abundant, small extended family groups gathered in larger camps. These large-scale social gatherings were important for trade and exchange, maintaining relationships, and ensuring the long term viability of smaller clans through intermarriage (Boileau 2007: 8).

These are just a handful of recorded examples of important ceremonial and sacred sites of the Kamilaroi people. It is evident that there are remains of many sites of significance in the local region. The known sites and physical evidence represent a fraction of what would once have been present.

Contact and Interaction

John Oxley explored the northern tablelands in 1818, including the Liverpool Plains. Squatters began to occupy the area in the 1830s, looking for suitable grazing land (NSW DPIE website, accessed August 2020). Relationships were ambivalent at first. With their detailed knowledge of the land and its resources, Aboriginal people were indispensable guides to Europeans. They often acted as go-betweens and

interpreters with local Aboriginal groups, and showed them the location of water and game. In turn the Kamilaroi came to value European axes, knives and items such as flour, tobacco and tea (Boileau 2007: 10).

In his diary entry for 9 December 1831, explorer Thomas Livingstone Mitchell described camping at a waterhole named Carrabobila. Mitchell notes:

The water, where we were encamped, was hot and muddy, but the blacks knew well how to obtain a cool and clean draught, by first scratching a hole in the soft sand beside the pool, thus making a filter, in which the water rose cool but muddy. They next threw into this some tufts of long grass, through which they sucked the cooler water thus purified also from the sand or gravel. I was very glad to follow the example, and I found the sweet fragrance of the grass an agreeable addition to the pleasure of drinking (cited in Boileau 2007: 10)

Two days later, upon reaching the Peel River, Mitchell described:

After a journey of thirteen miles we reached the bank of the Peel at Wallamoul. I gave to 'Jemmy', our excellent guide, the promised tomahawk, also a knife to 'Monday', his brother, whom he met here. I met at this place some intelligent natives, from who I learnt that the spot where Mr Oxley crossed the Peel in his journey, was about two miles down (cited in Boileau 2007: 10).

As time passed, land clearing, devastation of habitats and resources, destruction of sacred and ceremonial sites, disease, dispossession and seizure of Aboriginal women caused tensions between Aboriginal people and non-Aboriginal settlers which led to violence and murder on both sides. Several organised massacres took place in the region, including the infamous Myall Creek massacre. At this place, nearly 28 Wirrayaraay people were murdered at their camp by 11 local stockmen and station hands (NSW DPIE website, accessed August 2020). Another documented incident involved Thomas Simpson Hall in 1836, who attempted to establish a cattle run on pastures by the Gwydir River, and was met by strong resistance from the Kamilaroi, who killed one stockman and wounded others, forcing Hall to retreat. Hall returned to the area with a posse of mounted police, local squatters and farmhands, and shot a large number of Aboriginal people, killing an estimated 80 (Boileau 2007: 11).

Warren Newman and Lyall Green commented in *Tamworth: A Pictorial History* (1998):

... as settlement expanded, the Kamilaroi people dwindled. The killings played a part in this, but were not nearly as important a factor as the diseases which the settlers brought with them. Perhaps above all else, however, the Aboriginal people suffered from the environmental impact of white settlement. Favoured river sites and fishing holes were no longer available to them, grasslands were put under cultivation and lost forever, and sheep and cattle took over the land where kangaroos and other game had wandered freely (cited in TRC 2006: 6).

Jim Hobden's *History of Tamworth* also notes:

A few years after Oxley's cavalcade had passed through the valley, land seekers with herds and flocks began spilling over the Liverpool Range and onto the lush pastures. The natural game was driven away, the waterholes patrolled and the Aborigines given to understand they would not be tolerated. If natives protested or speared a beast because their usual game had been frightened away they were accused of being cheeky or treacherous and that meant that the white men would disperse them, which in other words meant, kill them (cited in TRC 2006: 6-7)

From 1883 the Aboriginal Protection Board began establishing Aboriginal stations and missions. The expansion of European settlement in the 1880s after the building of the railway further alienated Aboriginal people, who were forced from their lands onto reserves on the outskirts of towns (High Ground Consulting

2020: 10). During the 1940's and 1950's local Kamilaroi families were living in Aboriginal Reserves in areas such as North Tamworth (Boileau 2007: 15). Despite the hardships, displacement, genocide, murder and dispossession that Aboriginal people suffered as a result of European invasion, the Aboriginal community of the Liverpool Plains region is still strong and vibrant today.

Continued Connection

While many individuals that survived the European incursion would have left for other areas or been forced onto missions and reserves, some Aboriginal people stayed and worked within the developing industries of the region. These stories are often only glimpsed through brief mentions in historical recollections due to the biases of recordings. We do know, however, that Kamilaroi people are still connected to the Liverpool Plains area, to their country and are actively involved in continuing their culture and history. This is evidenced in part by the development over time of a Kamilaroi dictionary, containing definitions, grammar and English translations, ensuring the survival of the language to be passed on to future generations (Kamilaroi Website, accessed August 2020).

3.2 Heritage Register and Database Searches

The following heritage registers and database searches were undertaken as part of this preliminary assessment:

- National Native Title Tribunal (NNTT);
- Aboriginal Heritage Information Management System (AHIMS);
- The Australian Heritage Database (AHD);
- State Heritage Register (SHR) and Inventory (SHI); and
- Liverpool Plains Local Environmental Plan (2011).

3.2.1 National Native Title Tribunal

A search was undertaken of the National Native Title Register maintained by the National Native Title Tribunal (NNTT) on 4 August 2020 of the project area to identify if Native Title exist over the project area. The searches identified no approved Native Title claims within the project area, and an application for Native Title by the Gomeroi People, filed on 20 December 2011 (refer to **Appendix B**).

3.2.2 Aboriginal Heritage Information Management System (AHIMS search)

Searches were conducted of the AHIMS register on 3 August 2020 for any Aboriginal heritage sites recorded within and adjacent to the project area. The search covered the area datum: GDA, Zone: 56, Eastings: 273000 – 283000, Northings: 6524000 – 6534000 (approximate 1km buffer from the project area). Six Aboriginal sites and no Aboriginal places were listed (refer to **Appendix C**).

3.2.3 Australian Heritage Database

The Australian Heritage Database (AHD) is a Commonwealth administered heritage database that includes entries from the former Register of the National Estate and the current Commonwealth and National Heritage Lists. This database was searched on the 1 September 2020 for all Indigenous heritage items within the Liverpool Plains Local Government Area. The AHD search listed 11 results within the Liverpool Plains Shire LGA for heritage places. The only item in the vicinity of the project area is the Werris Creek Railway Station, which lies 800m to the west of the project boundary.

The results of the search identified no registered Indigenous heritage items within the project area.

3.2.4 NSW State Heritage Register and NSW State Heritage Inventory

The State Heritage Register is a heritage database administered by NSW Heritage of the Department of Premier and Cabinet. This database includes heritage listings for State significant heritage items. This database was searched on the 1 September 2020 for all Indigenous heritage items within the Liverpool Plains Local Government Area.

The results indicate 4 heritage places and no Aboriginal Places within the Liverpool Plains LGA. The Werris Creek Railway Station is the only item listed in Werris Creek.

The State Heritage Inventory is a heritage database administered by the NSW Heritage Branch of the Office of Environment and Heritage. This database includes heritage listings from local and regional planning instruments and heritage studies and state significant heritage items. This database was searched on the 1 September 2020 for all Indigenous heritage items within the Liverpool Plains Local Government Area.

The results of the search identified 115 places within the Liverpool Plains LGA, with 23 of those in Werris Creek. No registered Indigenous heritage items are adjacent to or within the project area.

3.2.5 Liverpool Plains Local Environmental Plan (2011)

The Liverpool Plains Local Environmental Plan (LEP) is a planning instrument administered by Liverpool Plains Shire Council, which contains provisions and listings of items of environmental heritage including heritage, conservation areas and archaeological sites within Schedule 5. The LEP was searched on 1 September 2020.

The results of the search identified no registered Indigenous heritage items within the project area.

3.3 Previous Archaeological Research

A review of the OEH AHIMS library and online searches were undertaken to obtain copies of previous Aboriginal heritage studies and archaeological investigations within the locality of the project area (refer to **Table 2**). This section discusses studies in the locality which can assist in building up a picture of the potential archaeology of the region. This in turn can help to predict the types of sites that may be expected to be present within the project area.

The AHIMS search identified six sites within a 6km radius of the project area. **Table 2** below summarises the AHIMS sites recorded in the vicinity of the project area. Few archaeological studies exist for the region around Werris Creek, with the exception reports undertaken for various expansions and assessments for the Whitehaven Coal Werris Creek Mine site. The two associated Aboriginal cultural heritage grinding groove sites on the mine's property (29-2-0005 and 29-2-0006) are located approximately 6.2km southwest of the project area.

An Aboriginal Heritage Assessment was completed for R. W. Corkery & Co. Pty. Limited (RWC) on behalf of Werris Creek Coal Pty Limited by Archaeological Surveys & Reports Pty Ltd (2004). In this study, surveys were undertaken to identify Aboriginal cultural sites and relicts for a heritage assessment for the development of the open cut mine. Grinding groove sites were already known to exist on the property, with some already removed from the "Narrawolga" property (AHIMS site 29-2-0005). The area surveyed was a small portion of the proposed mine site, partially across the properties "Narrawolga", "Eurunderee" and "Cintra". The grinding grooves site (AHIMS 29-2-0005) was relocated and recorded. The site was described as approximately 25 grinding grooves aligned north-south, over an area of approximately 90m by 35m. No

other sites were recorded on the properties (Archaeological Surveys & Reports Pty. Ltd. 2004). A subsequent report by Archaeological Surveys & Reports Pty Ltd (2007) details the salvage and removal of the Narrawolga axe grinding groove site.

A Heritage Management Plan was compiled for the Whitehaven Werris Creek Coal Mine by Advitech Pty Ltd (2014) on behalf of Werris Creek Coal. In this study, likely impacts of the Life of Mine project and measures implemented to manage Aboriginal and historical cultural heritage are outlined. Plans for the management of the “Narrawolga” grinding grooves site (AHIMS 29-2-0005) off-site are outlined. No further surveys were undertaken for this study and no sites were recorded.

Table 2. AHIMS Sites Recorded in the Region

AHIMS Site ID	Site Name	Site Type	Features	Number of Sites	Sites Within Project Area
29-2-0344	Marengo AS1	Open Site	Artefact scatter – siltstone medial flake with retouch, a quartzite flake, 1 distal chert flake and 2 distal chert flake fragments. Approximately 3.5km south of the project area.	1	0
29-2-0345	Railway View IA1	Open Site	Isolated artefact – siltstone distal flake recorded in cleared pastoral landscape approximately 3.4km south of the project area.	1	0
29-2-0005	Narrawolga	Open Site	Axe grinding grooves – site recorded in 2004, 2006 geotechnical assessment determined that site threatened stability of mine wall, site permitted to be removed/relocated to Willowtree Information Centre in 2006. Status not updated on AHIMS. Site was located within Whitehaven Coal Werris Creek Mine approximately 6.2km southwest of the project area.	1	0
29-2-0004	“Escott”; Werris Creek	Open Site	Artefacts – Quirindi and District Historical Society recording accounts from “Escott” property owner Mr A. Taylor regarding picking up “...several stone axe-heads on...my late property Escott”. The property is approximately 4km southwest of the project area.	1	0
29-2-0006	Werris Creek	Open Site	Axe grinding grooves on “Narrawolga” property near AHIMS site 29-2-0005. Grooves on sandstone ridge with spring approx. 700 yards east of ridge. Site was not inspected: “I understand that these are comparable with the other sites in the district” – remarks from Mr. O'Donnell (recorder). Unclear if referring to grinding grooves on Whitehaven Coal Werris Creek Mine 29-2-0005 (potential duplicate). The site is approximately 6.2km southwest of the project area.	1	0
29-2-0009	Torryburn Marking	Tribal Open Site	Modified Tree – Scar in living yellow box tree 8m above ground level. Located approximately 17km east of project area.	1	0

3.4 Regional Character

The low density of sites in the area should not be seen to represent the density or distribution of sites across Werris Creek, as most sites are recorded during investigations required for development. In cases such as Werris Creek where major modern developments have been sparse, an accurate record of Aboriginal cultural heritage sites and relics across the landscape may currently not exist. Instead, the low density should reflect firstly the absence of development, and in part that the cleared pastoral landscape may have obscured or disturbed sites which could have otherwise been more immediately obvious to observers.

While the archaeological record may assist in building a picture of how the Kamilaroi people lived in the region in the past, most of what is understood about the associated material record is from a select few studies in the broader Liverpool Plains and New England areas. Here, the Kamilaroi people had a prior presence for many thousands of years. They continue to play a role in the management and proliferation of their culture and traditions and maintain strong connections to the land and their communities.

The Kamilaroi people formed part of a wider indigenous nation which extended from around Singleton in the Hunter Valley to the Warrumbungle Mountains in the west and up through Narrabri, Walgett, Moree and Mungindi in NSW to Nindigully in south-western Queensland (TRC 2006: 5). A large variety of sites containing physical evidence of past Aboriginal land use remain within the broader region. Site types include bora grounds/ceremonial grounds, grinding grooves, campsites, artefact scatters, stone quarries, isolated finds, scarred and carved trees. From the few studies around Werris Creek, site types so far include grinding groove sites, scarred trees and open artefact scatters.

The earliest dates for human occupation in the region are 4,950 BP from Bendemeer rock shelter on Glendon Station and 3,600 BP from Moore Creek 4 rock shelter. In their *Tamworth Aboriginal and Archaeological Study*, Wilson and McAdam (2000) suggest that in light of the dates for the wider region, it is likely that the Kamilaroi have occupied their country for at least 20,000 years, and these dates may be extended with further excavations in the area (Boileau 2007: 8).

To better understand the potential for Aboriginal material culture around Werris Creek, areas which have been more intensively investigated can be used as a guide. A pivotal example from the region is the study by Wilson and McAdam (2000), who used historical accounts, Aboriginal oral history, and previous archaeological research to make a number of observations and predictions concerning site types within the New England area, focusing on Tamworth and the likelihood of site survival. These observations include:

- The most common artefact types being flakes, broken flakes, retouched flakes, flaked pieces and cores;
- Raw materials including chert, cherty argillite, hornfels, quartz, andesitic, greywacke tuff and chalcedony;
- All sites being within 400 metres of a water source;
- Modified trees and artefact scatters located usually within 150 metres of a water source;
- Larger sites containing greater numbers and types of artefacts generally being found near more permanent creeks, springs, or water holes/rockpools, and smaller sites with less artefact variety generally occurring near small tributaries and the upper reaches of intermittent creeks;
- Modified trees being commonly white box or red river gum (Wilson and McAdam 2000: 60-70);
- Burials occurring along water courses;
- Ceremonial grounds being found within 600 metres of the ecotone between alluvial flats on water courses and red brown solodic soils on slopes and crests; and
- South of the Peel River, sites most likely consisting of highly disturbed artefact scatters and the occasional scarred tree (Wilson & McAdam 2000: 98-99).

Evidence of a long period of Aboriginal occupation of the Tablelands exists in the form of a rich and varied archaeological record for the region. The many site types help to build a better understanding of Aboriginal customs, culture and traditional land management practices prior to the arrival of Europeans. Site types in the region include rock art sites, camp sites, open artefact scatters, scarred or carved trees for ceremonial and utilitarian purposes, grinding grooves for sharpening tools, quarry locations at sources of raw material, ceremonial rings in flat, exposed basalt and granite outcrops, burials associated with scarred trees (e.g. AHIMS site 21-4-0006 at Bora Mountain), hearth sites, and shell middens in proximity to water sources (Knuckey 2019: 17-18). Grinding grooves in silcrete outcrops have also been recorded throughout the New England region, including at a significant site at Uralla. While many of these types of sites have low potential for preservation due to intensive historical land clearance for pastoralism, agriculture and mining, it

nevertheless plays a role in helping to predict and develop a framework for the management of Aboriginal cultural heritage in the project area.

3.5 Summary

The results of the background archaeological research, including heritage searches and a review of previous assessments in the region indicate that the most common site type in the project area vicinity are artefact sites, followed by scarred trees. The archaeological context of the project area indicates that evidence of Aboriginal occupation is most likely to occur in proximity to permanent water sources, dependent on the impacts of previous land use history.

The results of background archaeological research, including heritage searches and a review of previous archaeological assessments in the region, indicate that the most common site types in the region are artefact sites, followed by grinding grooves and scarred trees. Despite heritage register searches indicating that no sites have been recorded in the project area or immediate vicinity there is a rich and varied archaeological record for the broader Liverpool Plains and New England regions across a variety of landforms. Site types in the broader region include rock art sites, camp sites, open artefact scatters, scarred or carved trees for ceremonial and utilitarian purposes, grinding grooves for sharpening tools, quarry locations at sources of raw material, ceremonial rings in flat, exposed basalt and granite outcrops, burials, hearth sites, and shell middens in proximity to water sources.

The archaeological context of the project area and the potential for moderate to deep soil profiles indicates that evidence of Aboriginal occupation is likely to occur in the project area, though visibility is dependent on the impacts of previous land use history.



Figure 3
Project Area and Known
Aboriginal Heritage Sites

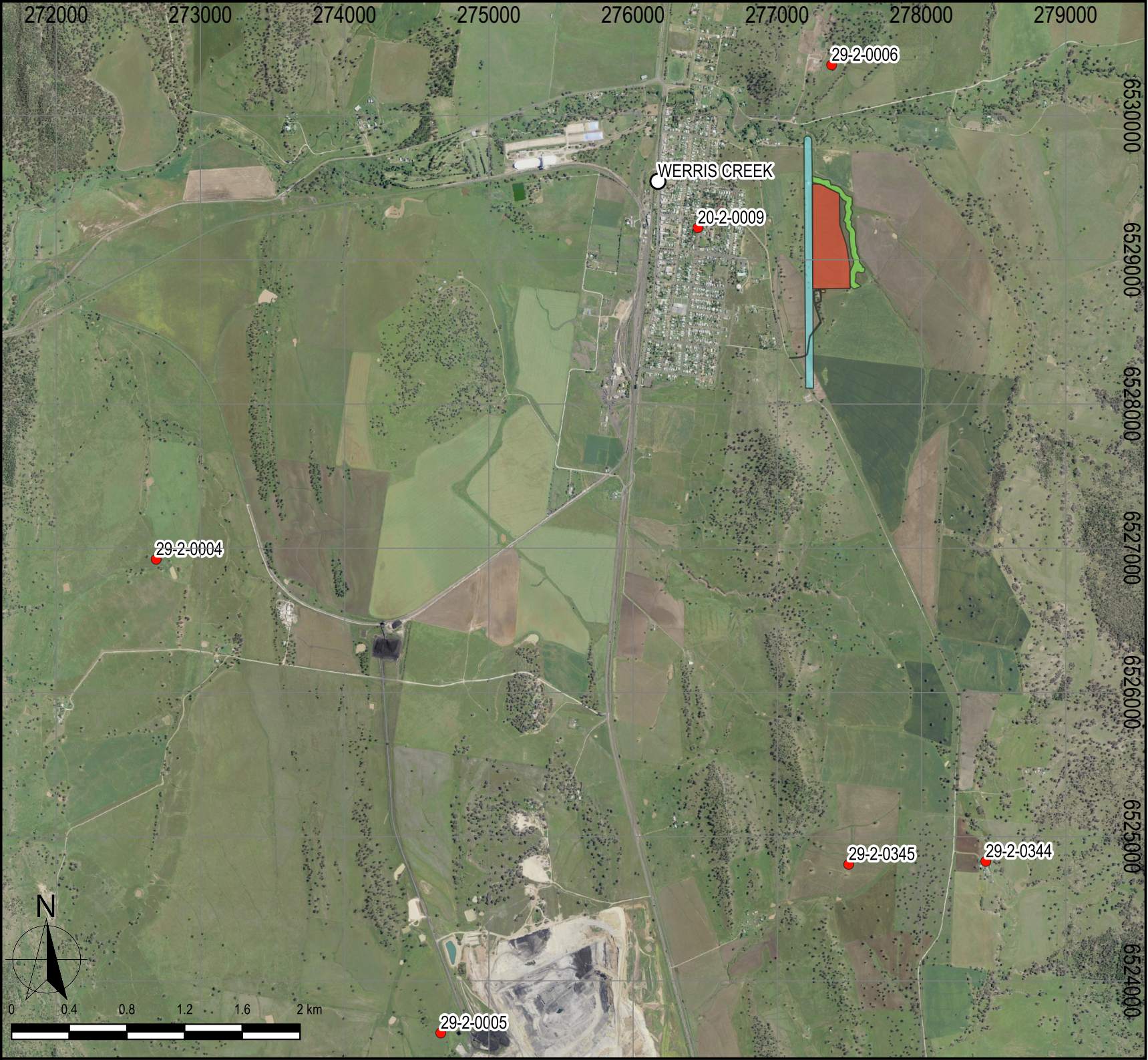
Legend

- AHIMS Sites
- Major Towns/Cities
- Locality

- Proposed Works
- Solar Farm Area
 - Essential Energy 66kv Sub-Transmission and Easement
 - Transformers, Inverters, Metering and Storage
 - Riparian Zone and Ridgeline Aesthetic Screening
 - Proposed Permanent Access Road



Source: NSW Spatial Services, AHIMS, Wynergy PTY LTD
Projection: GDA94
Maps and figures contained within this document may be based on third party data, may not be to scale and are intended for use as a guide only. Virtus Heritage does not warrant the accuracy of such maps or figures.



4. PREDICTIVE MODEL AND ARCHAEOLOGICAL POTENTIAL

Based on the known archaeological, environmental and landscape context of the locality, a predictive model for evidence of Aboriginal occupation for the project area is presented below:

Aboriginal axe grinding grooves are grooves most often found in sandstone where Aboriginal people have sharpened or manufactured stone axes and other implements and in some cases, ground seed and grains in the sandstone forming 'bowls'. This site type is also known to occur in silcrete and sandstone, at significant distance from water sources, in the project area region. This site type may occur in the project area where suitable geology is present.

Scarred trees and **carved trees** contain evidence of scars and carved patterns which can be attributed as having Aboriginal cultural origin. Scarred trees are typically created by the removal of bark from the trunk of the tree (usually with a stone axe) to make shields, canoes, implements and other types of items which leave a wound on the tree trunk. Carved trees contain carved patterns on the tree trunk and are often found in association with ceremonial grounds, burials or cultural sites. Carved trees are a rare site type, with one known example in the region. The potential of a scarred tree to occur is low however, due to a long history of forest clearance and intensive agriculture. Scarred trees may be found where areas of mature trees are still present within the project area.

Isolated artefacts and **open campsites (artefact scatters)** are the locations of discarded stone artefacts, often material that has been discarded as part of making stone tools or over frequent episodes of occupation/visitation in an area. This site type can be found on any landform, but the objects are most likely to be found in proximity to major water courses, on low gradient landforms adjacent to water courses, on crests, ridgetines and spurs where the landscape has not been heavily modified.

Middens are the accumulation of debris from fish, crustaceans and shell fish (shells, fish bones) consumed as part of Aboriginal people's diet. Middens also often contain charcoal, stone artefacts, bone and other types of material used by Aboriginal people. Middens often occur within close proximity to freshwater and saltwater sources which have potential to contain mussels, oysters and other types of edible shellfish. This site type is unlikely to occur in the project area due to distance to a permanent major watercourse.

There are no known **burial sites**, **bora grounds** or **stone arrangements** within the project area based on Aboriginal consultation to date and preliminary previous archaeological and historical research for this assessment. Burials associated with scarred trees are known to occur in the project area region however, burial sites are a very rare site type and are unlikely to be found within the project area. Bora grounds are known to occur in the region on flat basalt and granite outcrops, this site type may occur in the project area where suitable geology or landform occurs.

Petroglyphs (also referred to as Rock Engravings) are art sites where marks have been made in stone by Aboriginal people (for example, spirit figures, animals, implements and footprints). **Rock shelter sites with art** consist of rock overhangs used for shelter by Aboriginal people and where smooth surfaces on the walls of the shelter (sandstone surfaces) are painted with ochres and pigments) and **rock shelter sites with occupation deposits** include sediment deposits that potentially retain archaeological material. Rock shelter sites are unlikely to occur in the project area due to a lack of suitable geology, petroglyphs may occur in the project area where suitable outcropping geology occurs.

Potential Archaeological Deposits refers to soil profiles within landforms which are predicted to contain buried evidence of Aboriginal occupation. This buried evidence is most often stone artefact scatters which survive most frequently in the archaeological record. In the region, buried archaeological deposits are nearly always found within the A unit soils (topsoil) or in alluvial deposits at depth. Occasionally artefacts are found in the B horizon in cracking clays where artefacts have moved down from the topsoil. How archaeological potential is defined and to be assessed in this report is provided in **Table 3**.

Table 3. Definitions of Archaeological Potential

ARCHAEOLOGICAL POTENTIAL	DEFINITION
Low to Zero	Landforms that have been totally modified and have low to zero potential for any remaining original soil profile or intact archaeological deposits. This category includes existing roads, quarry areas or any area where the original soil profile (topsoil – A horizon) has been stripped and the landform completely modified. This landform may also include areas where there is no intact A horizon soils due to high levels of erosion.
Low	Landforms that may have been utilised by Aboriginal people in the past, but at a lower intensity relative to all surrounding landforms, resulting in a lower artefact density than all surrounding landforms. This category also includes landscape areas of low terrain integrity, where geomorphic processes or human action may have redistributed artefacts from their deposited locations, such as stripping of soil to create levees or excavation to create culverts, dams or bridges, resulting in site disturbance or destruction.
Moderate	Landforms that are predicted to have been utilised by Aboriginal people in the past, but not intensively or repeatedly. There is therefore potential for artefactual deposition, but at a lower frequency and density than in areas of high archaeological potential. This category may also refer to landforms known to be sensitive for higher levels of Aboriginal occupation but where prior ground surface disturbances has decreased the archaeological integrity and potential of finding evidence of Aboriginal occupation (for example, creek confluences, alluvial terraces where stratigraphic integrity may have decreased due to previous land use).
High	Landscape areas predicted to have been intensively or repeatedly utilised by Aboriginal people in the past, such as creek confluences, Pleistocene terraces, floodplains or elevated landforms above major watercourses or floodplains. In these areas, site and artefact density are expected to be higher than the surrounding landscape, and sites in these areas may possibly be more complex. Terrain integrity in these areas may be variable although prior ground surface disturbance should be low or non-existent. An important characteristic of areas of high archaeological potential is the research potential or the capacity of sites to provide valuable information on past Aboriginal land use.

The project area has been stripped of vegetation for cattle grazing and cultivation. Erosion due to the lack of original woodland and thus soil retention may have affected the preservation of Aboriginal sites and material evidence of occupation, however there is potential for intact archaeological deposits to occur in less disturbed areas of the project area.

4.1. Summary

The project area is in a disturbed landscape, however there is potential for Aboriginal objects and sites to occur, and intact deposits to be extant in areas of lower disturbance. The soil landscape and their associated geologies predicts that areas of moderate to deep soil profiles may occur.

5. SITE INSPECTION AND RESULTS

The site inspection was undertaken on the 28th August 2020 within lands in the Nungaroo LALC. The site inspection was undertaken by Jac Carr, Senior Archaeologist, Virtus Heritage and Mr David Horton, Sites Officer, Nungaroo LALC over a half field day. The proposal area was surveyed by pedestrian targeted survey, all areas of exposure, mature trees and drainage lines were inspected (refer to **Appendix D** for photographs of the site inspection).

5.1 Survey Results

General visibility in the project area was very poor due to thick vegetation coverage, however areas of exposure in very occasional erosion scours on drainage lines and vehicle tracks provided some visibility. Exposure in the project area was <5% and visibility also <5%. Where visible, soils were a dark brown silty loam with very limited inclusions. The project area is located within a meander plain, with a drainage line abutting the eastern boundary of the proposed activity area. Limited inclusions of quartz and weathered basalt bedrock were visible along and within the drainage line. The project area has been heavily disturbed by European land use associated with farming activities. The area has been previously cleared of trees and rock picked. The vegetation is Lucerne and Oats with a line of young native Eucalypts in the South west corner of the proposed activity area and slightly more mature trees adjacent north of the proposed activity area on the Werris Creek line. No Aboriginal sites or objects were observed in the project area and there is very low potential for intact archaeological deposits to occur due to the landform and prior land use disturbance observed.

5.1.1 Cultural Comments

During the survey, Mr Horton commented that he would like monitoring to occur when ground disturbance works occur and for a cultural heritage induction be given to all site workers. Mr Horton commented that given the landscape there is likely a low potential for cultural material to be present.

5.2 Summary of Site Inspection

There are no previously recorded sites within the project area based on heritage searches and background research of previous archaeological investigations to date. No Aboriginal objects or sites were observed in the project area and given the disturbance and location of the solar farm the project area is deemed to have a low potential for archaeological deposits.

6. RECOMMENDATIONS

The following recommendations have been made based on the information provided on project impacts, consultation to date, relevant archaeological and environmental background research, and the results of the site inspection.

- 1) No Aboriginal objects were identified during the site inspection. No Aboriginal places are registered within the project area. No areas of archaeological potential are identified within the project area requiring archaeological testing, salvage or mitigation
- 2) During the survey, Mr Horton commented that he would like monitoring to occur when ground disturbance works occur. KDC may consider the request, however cultural collection can only occur legally in consultation with the DPC Heritage NSW and relevant Aboriginal stakeholder groups as conditioned within an AHIP.
- 3) All site workers and personnel involved in site impact works associated with the proposal site should be inducted and briefed on the possible identification of Aboriginal sites and objects during construction and their responsibilities according to the provisions of the *NPW Act, 1974*, in case any unknown objects or items are uncovered during excavation.
 - a. As part of this induction, the contact telephone numbers of the DPC Heritage NSW regional archaeologist and EnviroLine 131 555, the relevant DPIE Environmental Officer responsible for this project should also be given to all site workers and personnel, in case unknown objects or items are uncovered during excavation.
 - b. Site workers should be made aware of Aboriginal objects and site types and their scientific and cultural significance and their legal obligations in relation to the protection and management of these Aboriginal sites under the NPW Act, 1974 and 2010 ancillary provisions and amendments.
 - c. As part of this induction, workers should be made aware that in the event that any suspected human remains are uncovered on site, the area of these suspected remains should be secured and cordoned off and the NSW Police notified. No further works can be undertaken until the NSW Police provide written advice. If these remains are deemed to require archaeological investigation by the NSW Police or NSW Coroner, then OEHL, the relevant Aboriginal parties must be notified. A plan of management for the preservation of any identified Aboriginal human remains or for their salvage must be put in place or conducted under a revised AHIP methodology and variation developed in consultation with all relevant Aboriginal parties and the DPIE.
 - d. During the survey, Mr Horton commented that he would like a cultural heritage induction be given to all site workers. KDC or the delegated authority may wish to consider the input and engagement of interested Aboriginal stakeholder groups and Nungaroo LALC in the development of inductions and tool box talks for this project.

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APPENDIX A

COMMENTS FROM
ABORIGINAL PARTIES



Virtus Consultation <consultation@virtusheritage.com.au>

Re: 200 - Menz Solar Farm Due Diligence - Finalising on Monday

1 message

Elaine Lin <e.lin@virtusheritage.com.au>

Fri, Oct 23, 2020 at 4:23 PM

To: allypatterson79@bigpond.com, nungaroo@bigpond.com

Cc: Mary-Jean Sutton <mj.sutton@virtusheritage.com.au>, Kale Langford <kale@kdc.com.au>, Virtus Consultation <consultation@virtusheritage.com.au>, Elle Lillis <e.lillis@virtusheritage.com.au>

Dear Ally and Nungaroo LALC,

I am writing to remind you that comments close at **5pm today**. We can still accept comments over email until next Monday. That is when we will be finalising and sending out the due diligence report for the Menz Solar Farm at Werris Creek. Thanks again for your time on this project and hope we get to hear from you. Have a lovely weekend.

Warm Regards,

Elaine Lin

Senior Archaeologist



VIRTUSHERITAGE

Mobile: 0416 494 341

Email: e.lin@virtusheritage.com.auWebsite: www.virtusheritage.com.au***Winner, Innovation for Cultural Heritage Services for NSW Business Chamber, Northern NSW Regional Awards, 2019*****Winner, Innovation for Cultural Heritage Services in Small Business Excellence Awards, Tweed Region (BEATS), 2019*****Finalist, National Small Business Champions Awards and NSW State Business Chamber Awards, 2019**

Think before you print.

Acknowledgement of Country

Virtus Heritage is committed to the spirit of reconciliation and acknowledges Aboriginal and Torres Strait Islander peoples as the First Australians and the Traditional Custodians of the states and territories of Australia. We recognise the Traditional Owners of the lands we work within. We pay our respect to Elders past, present and emerging in maintaining the culture, country and their spiritual and historical connections to the lands and waters.

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Virtus Consultation <consultation@virtusheritage.com.au>

200 Menz Solar Farm Werris Creek Due Diligence

1 message

Elle Lillis <e.lillis@virtusheritage.com.au>

Fri, Oct 9, 2020 at 1:45 PM

To: allypatterson79@bigpond.com, nungaroo@bigpond.com

Cc: Mary-Jean Sutton <mj.sutton@virtusheritage.com.au>, Kale Langford <kale@kdc.com.au>, Virtus Consultation <consultation@virtusheritage.com.au>, Elaine Lin <e.lin@virtusheritage.com.au>

Hi Ally and Nungaroo LALC,

Attached is a draft due diligence assessment report for the Menz solar project, Werris Creek, which David Horton and Jac assessed in August.
Can Nungaroo LALC please comment by Friday 23 October 2020?

We have included David's verbal comments in the report.

Kind regards

Elle Lillis

Senior Archaeologist



VIRTUSHERITAGE

Mobile: 0477 296 835

Email: e.lillis@virtusheritage.com.au***Winner, Innovation for Cultural Heritage Services for NSW Business Chamber, Northern NSW Regional Awards, 2019*****Winner, Innovation for Cultural Heritage Services in Small Business Excellence Awards, Tweed Region (BEATS), 2019*****Finalist, National Small Business Champions Awards, 2019****Acknowledgement of Country**

Virtus Heritage is committed to the spirit of reconciliation and acknowledges Aboriginal and Torres Strait Islander peoples as the First Australians and the Traditional Custodians of the states and territories of Australia. We recognise the Traditional Owners of the lands we work within. We pay our respect to Elders past, present and emerging in maintaining the culture, country and their spiritual and historical connections to the lands and waters.

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APPENDIX B

NATIONAL NATIVE TITLE TRIBUNAL SEARCH



Search National Native Title Register

The National Native Title Register (NNTR) is a register established under s. 192 of the *Native Title Act 1993* (Cth).

The NNTR contains determinations of native title made by:

- the High Court of Australia
- the Federal Court of Australia
- or a recognised body such as South Australia's Supreme Court and Environment Resources and Development Court.

Further [information about the NNTR](#) is available.

Tribunal file no.		Federal Court file no.		Short name
Case name		State or Territory	ALL▼	Registered Native Title Body Corporate*

Representative ATS/ body area

Legal process

Determination outcome

Determination date between

Local government area

Determination type

Liverpool Plains Shire Council

ALL

ALL

ALL

ALL

and

Sort by

Determination date

Search

***Please note: current contact details for the Registered Native Title Body Corporate are available from the Office of the Registrar of Indigenous Corporations www.oric.gov.au**

No results for current search criteria

APPENDIX C

AHIMS SEARCH

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 200 Werris Creek Solar

Client Service ID : 524797

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
29-2-0344	Marengo AS1	GDA	56	278735	6524983	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>		Doctor.Matthew Whincop,Whincop Archaeology Pty Ltd				<u>Permits</u>		
29-2-0345	Railway View IA1	GDA	56	277715	6524689	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>		Doctor.Matthew Whincop,Whincop Archaeology Pty Ltd				<u>Permits</u>		
29-2-0004	Escott;Werris Creek;	AGD	56	272400	6526400	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>		H Hammond				<u>Permits</u>		
29-2-0005	Narrawolga	GDA	56	274907	6523490	Open site	Destroyed	Grinding Groove : -	Axe Grinding Groove	
	<u>Contact</u>	<u>Recorders</u>		Quirindi District Historical Society,Doctor.Matthew Whincop,Whincop Archaeology				<u>Permits</u>	3792	
29-2-0006	Werris Creek;	AGD	56	277000	6529900	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	
	<u>Contact</u>	<u>Recorders</u>		D O'Donnell				<u>Permits</u>		
20-2-0009	Torryburn Tribal Marking	AGD	56	275980	6529353	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	<u>Contact</u>	<u>Recorders</u>		Ms.Suzanne Hudson				<u>Permits</u>		

Report generated by AHIMS Web Service on 03/08/2020 for Rachel (Elle) Lillis for the following area at Datum :GDA, Zone : 56, Eastings : 273000 - 283000, Northings : 6524000 - 6534000 with a Buffer of 1000 meters. Additional Info : Due Diligence Assessment. Number of Aboriginal sites and Aboriginal objects found is 6

This information is not guaranteed to be free from error omission. Office of Environment and Heritage (NSW) and its employees disclaim liability for any act done or omission made on the information and consequences of such acts or omission.

APPENDIX D

PLATES



Plate 1 Facing south from northern end of project area showing erosion along drainage line.



Plate 2 Facing north from northern end of project area. Mature trees (outside project area) on creek line in background.



Plate 3 Facing east along drainage line showing exposure on unnamed drainage line bank and edge of cropping paddock.



Plate 4 Facing east from project area showing ground coverage.



Plate 5 Facing south showing vehicle track exposure in cropping paddock.



Plate 6 Facing west from centre of project area, showing crop coverage.



Plate 7 Facing south from southern end of project area showing young Eucalypts.



Plate 8 Facing north from southern end of project area showing overview of project area, with solar farm area in cropping paddock in background.



Plate 9 Facing east from southern end of project area, with vehicle exposure.



Wynergy Pty Ltd

Wynergy - Werris Creek Solar Farm Flood Impact Study
Flood Study

September 2020

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1. Introduction

1.1 Background

Wynergy Pty Ltd on behalf of Menz Solar Farm Pty Ltd propose to develop a 4.995/MWAC / 5.2 MWAC Agrivoltaic Solar Farm at Lot 1 DP 509915 Black Gully Road, Werris Creek NSW. The proposal is located within Liverpool Plains Local Government Area (LGA) and is currently used for grazing purposes.

The site is located to the east of the town of Werris Creek, which is located approximately 37 kilometres south west of Tamworth. The site is located to the south of the channel and floodplain of Werris Creek, as shown on Figure 1-1.



Figure 1-1 Site location

The site is bounded to the north by Werris Creek, to the west by Werris Creek Stock Road, to the east by a small unnamed overland flow channel and to the south by farm land.

1.2 Purpose of this report

This flood study has been prepared to present flooding levels in Werris Creek along with overland flow conditions during the peak 1 in 100 or 1% Annual Exceedance Probability (1% AEP) rainfall event. This investigation includes modelling to determine any impacts on the proposed location of the solar farm.

1.3 Study methodology and outcomes

This study involves the following tasks:

- Delineate the upstream catchment areas.
- Develop a RORB hydrological model of Werris Creek to the location of the site.
- Include local catchment flows for the site using rain-on-grid method in TUFLOW.

- Simulate the 1 in 100-(1%) Annual Exceedance Probability (AEP) hydrograph at the site for a range of durations and report the “Critical Duration”.
- Compile a TUFLOW model from approximately 0.5 km upstream to approximately 1 km downstream of the site, including the local catchment to the site (for the purposes of the rain-on-grid modelling).
- Simulate the flood conveyance of the ‘critical duration’ 1% AEP flood event at the site under existing conditions.
- Produce flood mapping of flood depth, flood level at the site, including both Werris Creek and local flows.
- Provide a short report of the findings, supported by flood mapping. This report has been prepared to a suitable standard for submission with a Development Application for the site.

1.4 Scope and limitations

This report: has been prepared by GHD for Wynergy Pty Ltd and may only be used and relied on by Wynergy Pty Ltd for the purpose agreed between GHD and the Wynergy Pty Ltd as set out in Section 1.2 of this report.

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2. Proposed development

The Menz Solar Farm is a 5 MW Agrivoltaic solar farm being developed by Wynergy Pty Ltd. The site is located 500 m east of the Werris Creek township, which lies on the Northwest slopes and plains in North-western NSW.

The project will use 2Panel Single Axis Trackers to connect to the 11 kv Essential Energy distribution network. The use of the selected infrastructure will enable the site to be designed in an Agrivoltaic manner which enhances the colocation of operations in delivering greater energy and agricultural yields.

The proposed solar generation will deliver 12 GWh of clean, renewable energy into the national grid, equivalent to the energy consumption of 1600 average Australian homes.

3. Hydrologic assessment

3.1 Werris Creek Hydrological Model (RORB)

A RORB hydrological model was developed for the hydrological assessment. The Cockburn River catchment areas draining to the site were delineated from 5 m gridded LiDAR data. The catchments were generally delineated into equal areas to represent main tributary catchments, and to represent junctions of major watercourses shown in Figure 3-1.

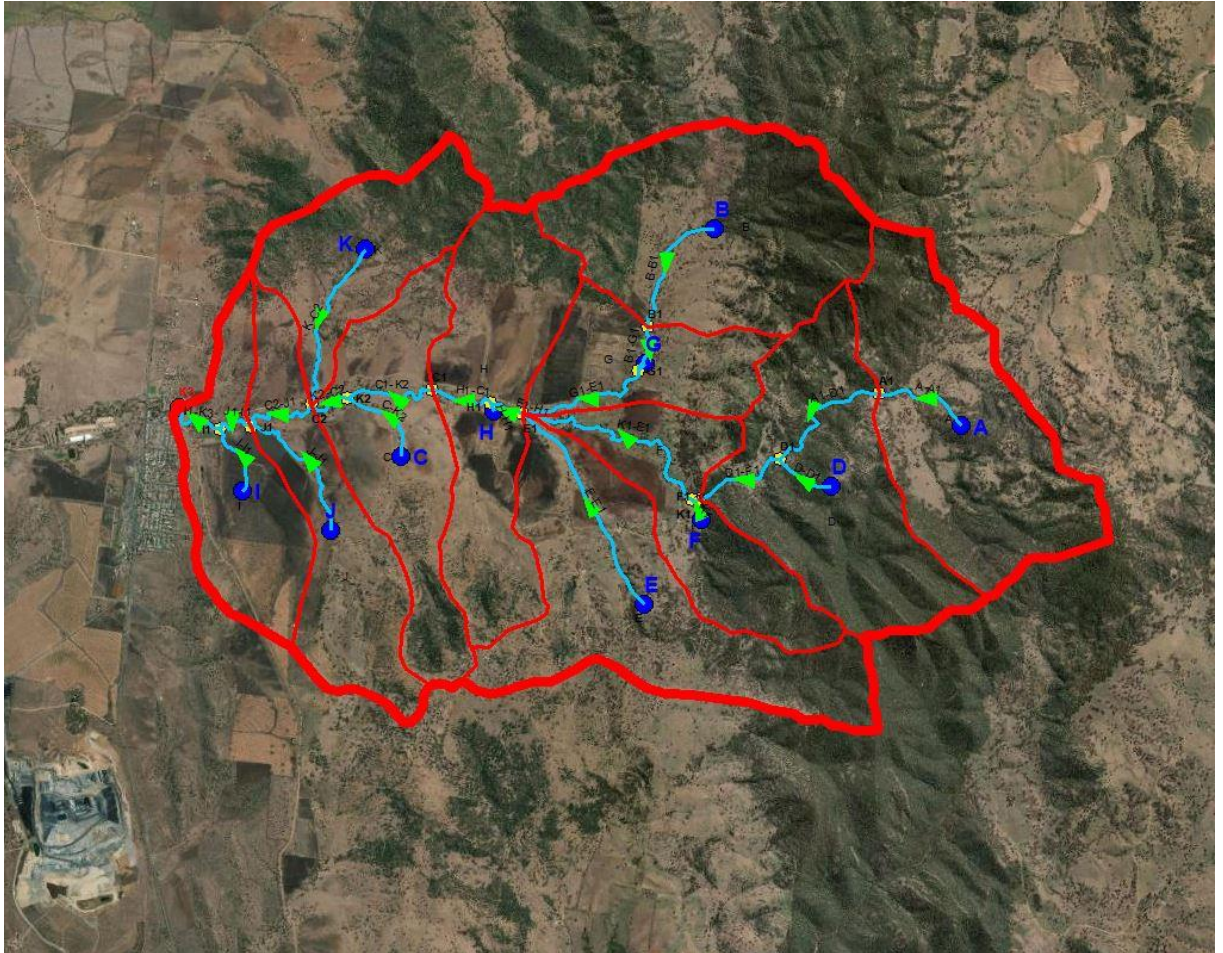


Figure 3-1 RORB Catchment map

The total upstream catchment area determined from the catchment delineation is approximately 70.3 km². Due to the nature of the catchment, natural reach types have been adopted.

3.1.1 Initial and continuing losses

Initial and continuing losses of 16 mm and 0.48 mm/hr were adopted from the ARR Data Hub. A multiplication factor of 0.4 adopted for continuing loss as suggested by ARR Data hub-NSW Specific Data info.

3.1.2 Rainfall

The Australian Rainfall and Runoff 2016 Intensity-Frequency-Duration (IFD) parameters were downloaded from the Bureau of Meteorology website and applied to the RORB model for the purposes of this assessment.

Coordinates entered into the IFD system were latitude -31.348, Longitude 150.658.

3.2 Adopted Werris Creek flows

The flood peaks for Werris Creek from the RORB hydrological model using the adopted k_c value are presented in Figure 3-2 for a range of storm durations and temporal patterns.

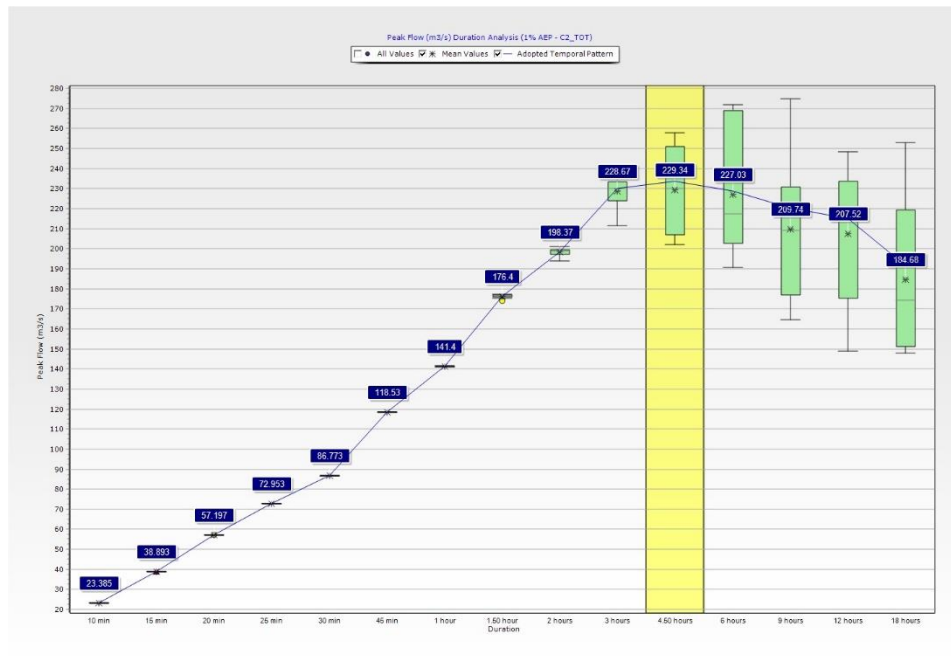


Figure 3-2 RORB flow rates

The results show that the critical duration storm is the 4.5-hour storm, Temporal Pattern 2332, with a peak flow rate of 233.8 m³/s. This storm event results in the peak flow rate due to the substantial catchment area upstream of the site. The 4.5 hour storm duration was adopted for the purpose of further assessment in the hydraulic modelling.

3.1 Local flows (rain-on-grid)

The critical rainfall event developed in the RORB modelling has been used in the rain-on-grid model of the local catchment. The extent of the rain on grid modelling is shown in yellow in Figure 3-3.

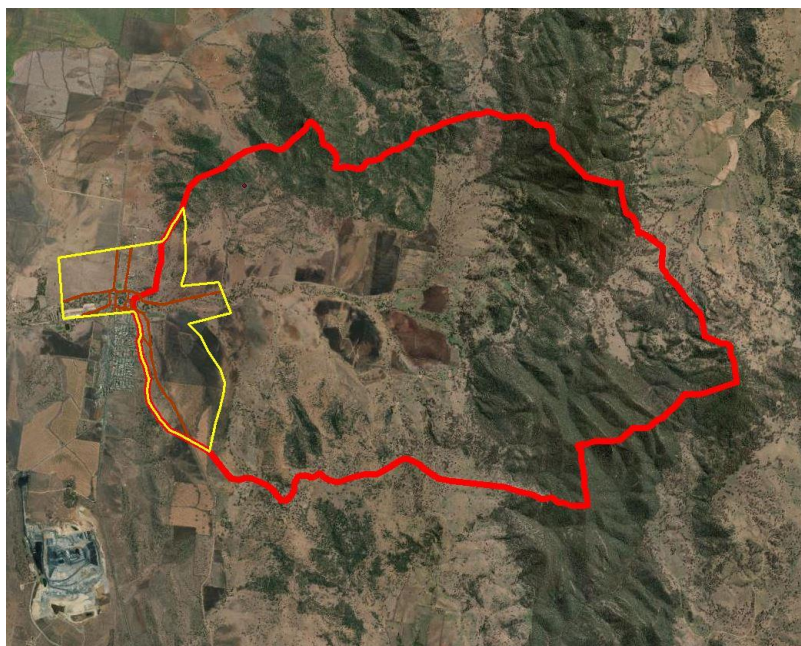


Figure 3-3 Rain-on-grid catchment map

4. Flood assessment

4.1 Flood model

A two-dimensional hydraulic model (TUFLOW) was developed for the site. The hydraulic model simulated an area from approximately 1 kilometre upstream of the site to approximately 2.0 kilometres downstream of the site.

4.1.1 Model configuration

The TUFLOW model was prepared using available LiDAR topography for the area, sourced from the NSW Land and Property Information (LPI) datasets. A 5 metre grid size was adopted for the purpose of preparing the model, based on a desktop review of the site topography and Cockburn River adjacent to the site to capture the in-bank channel geometry.

4.1.2 Boundary inflows

A single boundary inflow hydrograph was configured in the TUFLOW model at the upstream extent of the model. No other inflows along the length of the flood model were applied as main stream flooding would be expected to dominate peak flood levels in this area and local runoff would rise and fall well before mainstream flooding occurs. A Stage-discharge boundary was applied at the downstream extent of the hydraulic model based on normal slope calculations of the Werris Creek at this location.

4.1.3 Manning's "n" values

Hydraulic model roughness was configured in the flood model based on surface mapping delineations of the model extent using recent aerial imagery, shown in Figure 4-1.

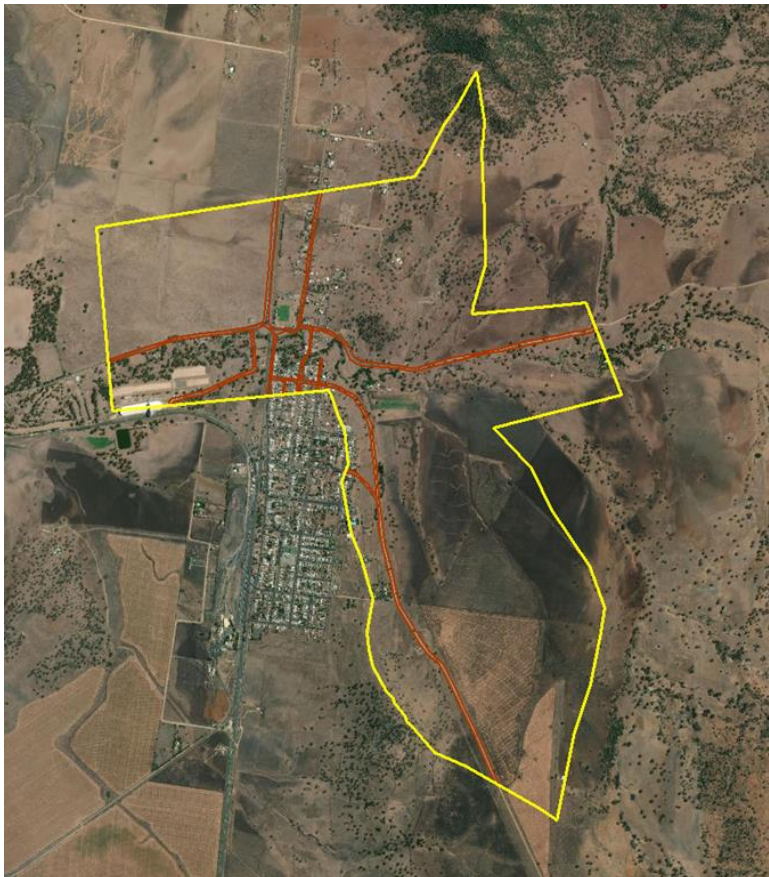


Figure 4-1 Roughness map

The adopted Manning's "n" values are shown below in Table 4-1.

Table 4-1 Adopted Manning's "n" values

Surface type	Adopted Mannings "n" value
Short grasses	0.030
Dense vegetation	0.070
Light Vegetation	0.050
Roadways	0.025

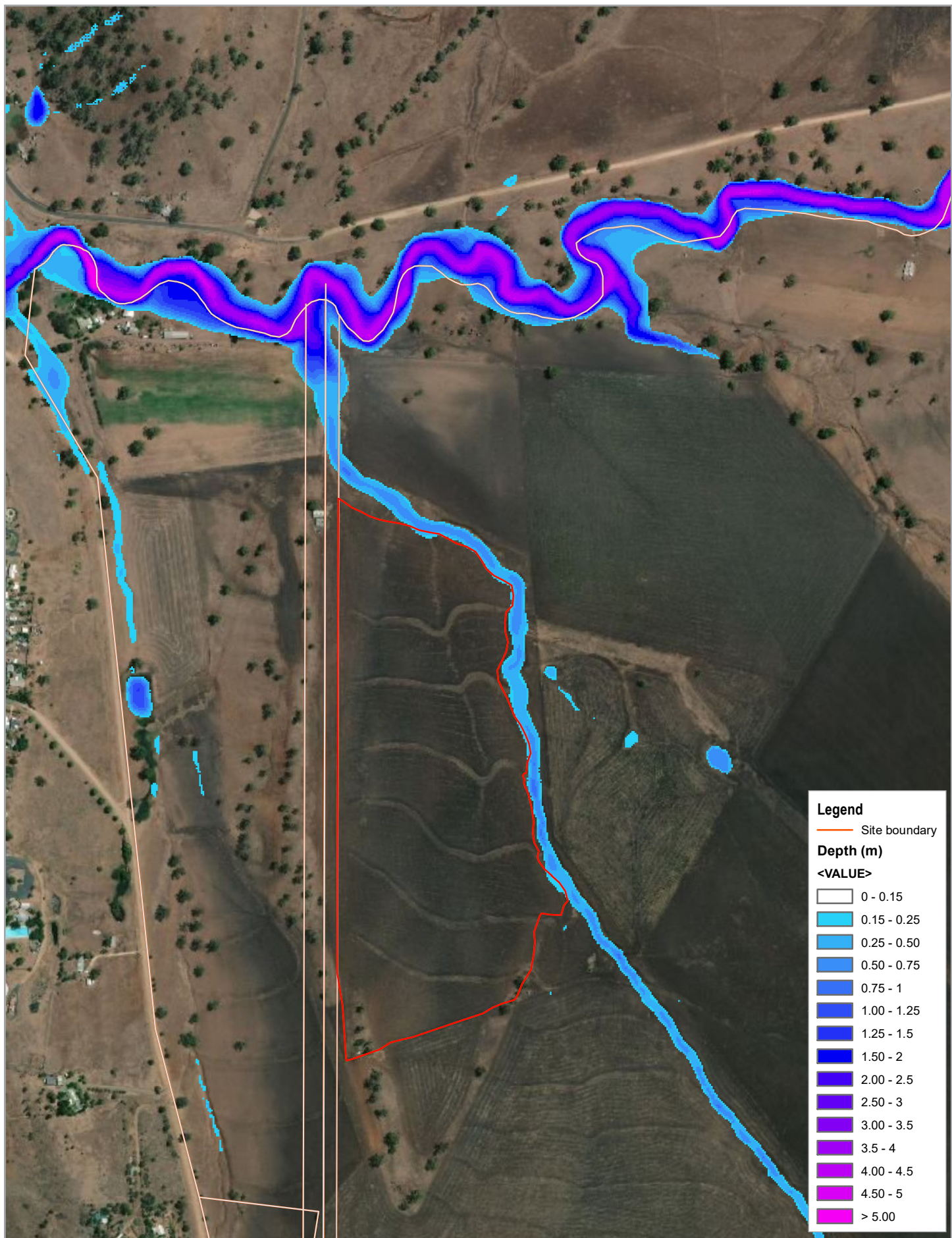
4.2 1 in 100 (1%) AEP results

4.2.1 Flood mapping

The results of the flood modelling investigation have been mapped and provided in Figure 4-2.

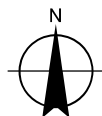
The modelling investigation has calculated that the proposed site of the solar farm is not impacted by flooding from Werris Creek during the 1 in 100 (1%) AEP peak median flood event.

Flooding from the local catchment is apparent on the eastern boundary of the project site, within the small local drain.



Paper Size ISO A4
 0 0.05 0.1 0.15 0.2
 Kilometers

Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 56



Wynergy Pty Ltd
 Werris Creek Solaar Farm Project
 Flood Impact study

**Maximum Flood Depth
 1% AEP**

Project No. 22-12537687
 Revision No. 0
 Date 27 August 2020

FIGURE 4.2

5. Conclusion and recommendations

This report outlines the flooding investigation carried out to support the design and development application for the proposed Werris Creek Solar Farm. Wynergy Pty Ltd on behalf of Menz Solar Farm Pty Ltd propose to develop a 4.995/MWAC / 5.2 MWAC Agrivoltaic Solar Farm at Lot 1 DP 509915 Black Gully Road, Werris Creek NSW.

The flooding investigation involves generation of flow rates for Werris Creek and local catchment runoff for the site using the methodology outlined in Australian Rainfall and Runoff 2016.

Main channel flows in Werris Creek have been calculated using the hydrologic modelling software RORB, with local overland flows calculated using the rain-on grid method in the TUFLOW hydraulic model developed for the site.

The modelling undertaken as part of this investigation has calculated that the proposed site off the solar farm is not subject to flowing in Werris Creek during the 1 in 100 (1%) Annual Exceedance Probability storm event.

Local flows during this event are modelled in the channel along the eastern boundary of the site. This report concludes by recommending that no infrastructure be located within this flooded area, with a finer resolution model be used at the detailed design stage to model flows within this channel. This higher resolution modelling will not need to include modelling of Werris Creek.

Appendices

Appendix A – Model summary sheet

GHD WERRIS CREEK MODELLING SUMMARY SHEET .DOCX

MODEL SUMMARY SHEET – 21 AUGUST 2020



Date: 21 August 2020

Prepared By: Hanieh Kosari

Distribution: WYNERGY Pty Ltd
Nigel Bosworth

Client Company
GHD

Criteria/Parameter/Type	Value/Description	Source/link	Comments/departures
Models used			
TUFLOW	Hydraulic modelling		Rainfall-on-grid Inflow hydrograph
RORB	Hydrology modelling		Flows developed for Werris Creek
Storminjector	Hydrologic model analysis		
Topography			
LiDAR	5.0 m DEM from Elvis Elevation\NSW Government - Spatial Services\DEMs\5 Metre	https://elevation.fsdf.org.au/	Tile extents used: North west: Tamworth201602-PH03- AHD_2766532_56_0002_ 0002_5m.asc South east: Tamworth201602-PH03- AHD_2886526_56_0002_ 0002_5m.asc
Recurrence Interval			
IFD Data	2016 Design Rainfalls	http://www.bom.gov.au/water/designRainfalls/revised-ifd/ issued 24.08.2020	Requested coordinates: Longitude: 150.658 Latitude: -31.348 Zone 56
Design AEP	1 in 100 (1%)		ARR 2016
Durations modelled			
Storm events	10 min to 1080 min storm durations was modelled	https://data.arr-software.org/	Peak median occurs for 270 min duration, temporal pattern 2332 (TP08)
Roughness			
Floodplain roughness	0.07 for dense vegetation 0.03 for short grass 0.05 for light vegetation 0.025 for roadways		
Losses			
Initial loss Continuing loss	IL = 16 (mm) CL = 0.48 (mm/h)		A multiplication factor of 0.4 adopted for Continuing loss as suggested by ARR Data hub-NSW Specific Data info
Aerial photography			

GHD WERRIS CREEK MODELLING SUMMARY SHEET .DOCX

MODEL SUMMARY SHEET – 21 AUGUST 2020



Criteria/Parameter/ Type	Value/Description	Source/link	Comments/departures
Google satellite/Nearmap	-	-	GIS basemap
Site Inspections			
-	-	-	-
Blockage factor			
-	-	ARR Chapter 8	
Grid size			
grid	5.0m grid		
Boundary conditions			
Upstream	Total inflow		
Downstream			
Coordinate system			
MGA Zone 56 GDA 94	Zone 56		
Model extent			
Site Plan sent by email in dwg file	E N		
Previous studies or modelling investigations			
External	no	-	-
GHD	no		-

GHD

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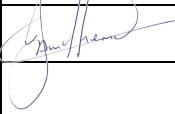
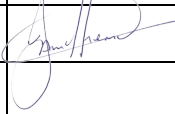
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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	Nigel Bosworth	James McPherson		James McPherson		08/09/2020

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Flora and Fauna Assessment Report



KDC Pty LTD

Menz Solar Farm

962 Black Gully Road, Werris Creek NSW
(LOT 1 DP 509915)

16 October 2020

Flora and Fauna Assessment Report

Menz Solar Farm
962 Black Gully Road, Werris Creek NSW (LOT 1 DP
509915)

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- Appendix 1: Site photographs
- Appendix 2: Flora Species List
- Appendix 3: Threatened Species 'Likelihood of occurrence'
- Appendix 4: EPBC Act Protected Matters Search Report
- Appendix 5: Assessment of significance (pursuant to Section 7.3 of the BC Act)
- Appendix 6: Licenses and Permits

1. INTRODUCTION

1.1 PROJECT BACKGROUND

Kleinfelder were engaged by KDC Pty Ltd to prepare a Flora and Fauna Assessment Report (FFAR) for the proposed Menz Solar Farm located at 962 Black Gully Road, Werris Creek NSW (Lot 1 DP 509915) (**Figure 1**). The project will be assessed under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) with Liverpool Plains Shire Council as the determining authority.

The following terms are used throughout this report to describe geographical areas (**Figure 2**):

- Study Area – LOT 1 DP 509915.
- Subject Site (development footprint) – areas of the Study Area proposed for development
- Locality – land within a 10 km radius of the Study Area.

This report identifies flora, fauna and threatened species present, or likely to occur within the Study Area based on species and/or habitats detected during field surveys and threatened flora and fauna records from the locality. An assessment of the likely impacts on identified threatened species, habitat features, wildlife corridors and vegetation communities as a result of the proposed development is also undertaken.

1.2 SITE DESCRIPTION

The Study Area is located east of the township of Werris Creek within the Liverpool Plains Shire Council Local Government Area (LGA) and is zoned 'RU1 – Primary Production' under the Liverpool Plains Local Environmental Plan (Liverpool Plains LEP, 2011). The predominant land use within the locality is agricultural development.

The northern boundary of the Study Area is bordered by Werris Creek and the east and south are bordered by neighbouring agricultural properties. The western boundary is bordered by Russell Street and Black Gully Road.

The topography slopes gently towards the three tributaries of Werris creek which run along the eastern and western boundaries and through the centre of the Study Area. Four small dams are located within the Study Area.

One First order stream occurs within the Subject Site, crossing the proposed access road in the south. No dams occur within the Subject Site. Existing powerlines run north-south within the western boundary of the Subject Site.

The majority of the Subject Site has previously been cleared of native vegetation for agricultural development, with the exception of a patch of remnant trees in the south-western corner. This vegetation forms part of a tree-lined ridge running north-south along the western boundary of the Subject Site.

Site photographs are provided in **Appendix 1**.

1.3 PROPOSED DEVELOPMENT

The Werris Creek Farm Project will consist of infrastructure associated with the Menz Solar Farm, which is a 4.995MWAC / 5.2MWDC Agrivoltaic Solar Farm development. The project study area evaluated 2 project stages. For the purpose of this report, we will focus only on stage one consisting of 5MW consisting of 3 rows of 216 trackers. Access will be achieved via Black Gully Road, which will lead via a proposed access road to the storage and construction staging area.

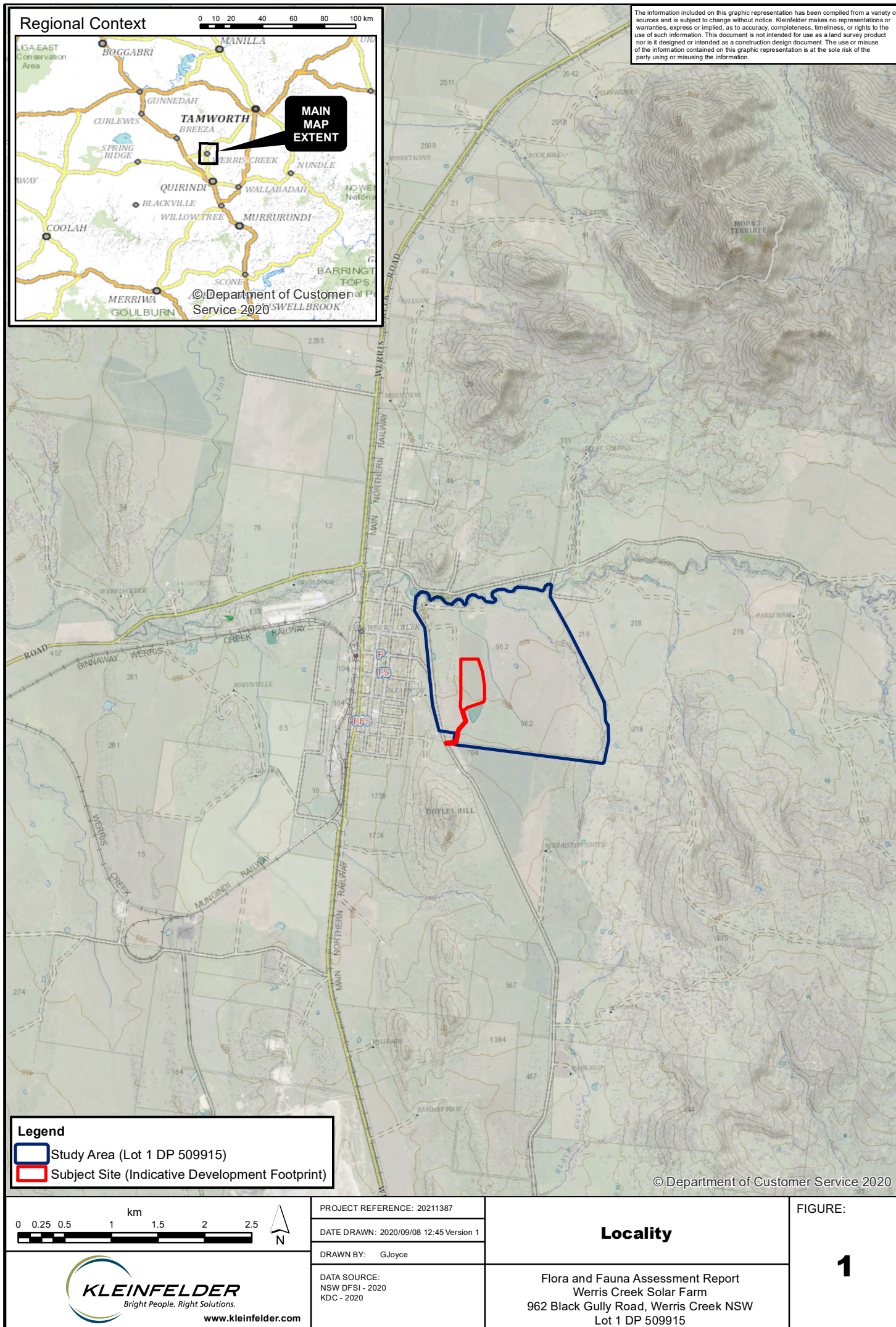
The project layout has been designed to avoid native vegetation and mapped waterways. The proposed project layout is provided in **Figure 3**.

1.4 REPORT OBJECTIVES

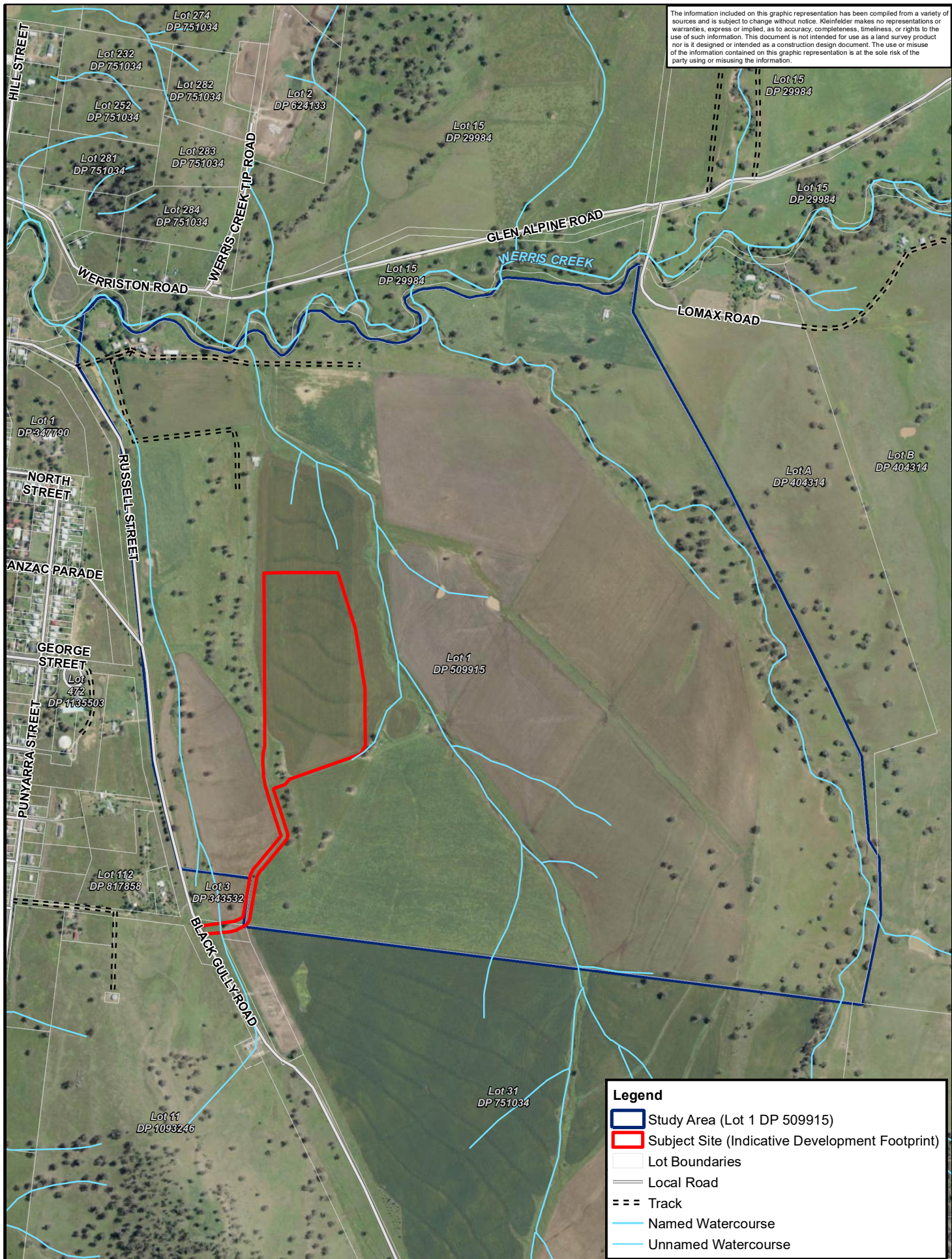
The objectives of the FFAR are to:

- Describe the flora and fauna (and their habitats) present on, or likely to occur on the Subject Site.
- Assess the relevance and value of the Subject Site for threatened species and ecological communities (and their habitats) listed under the NSW *Biodiversity Conservation Act 2016* (BC Act).

- Assess the potential impacts of the proposed development on threatened species and ecological communities, pursuant to Section 7.3 of the BC Act (5-part test).
- Comment on the likely occurrence and relevance of matters of national environmental significance listed under the Commonwealth *Environment Planning and Biodiversity Conservation Act 1999* (EPBC Act).
- Describe steps to avoid and mitigate any identified impacts on flora and fauna and to protect the natural environment of the Subject Site.



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DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2020
KDC - 2020

Subject Site and Study Area

Flora and Fauna Assessment Report
Werris Creek Solar Farm
962 Black Gully Road, Werris Creek NSW
Lot 1 DP 509915

FIGURE:

2

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DATA SOURCE:
NSW DFSI - 2020
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Daniel Lawless Drafting Service - 2018

Proposed Site Layout (Stage 1)

Flora and Fauna Assessment Report
Werris Creek Solar Farm
962 Black Gully Road, Werris Creek NSW
Lot 1 DP 509915

FIGURE:

3



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2. LEGISLATIVE CONTEXT

2.1 FEDERAL LEGISLATION

2.1.1 Environment Protection & Biodiversity Conservation Act 1999

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on 'matters of national environmental significance' undergo an assessment and approval process. Under the EPBC Act, an action includes a proposal, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. An action that 'has, will have or is likely to have a significant impact on a Matter of National Environmental Significance (MNES)' is deemed to be a 'controlled action' and may not be undertaken without prior approval from the Australian Minister for the Environment.

The EPBC Act identifies nine MNES:

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

As part of the current assessment, MNES that are predicted to occur within the locality (applying a 10 km buffer) were obtained from the on-line Protected Matters Search Tool (DoEE, 2020a). These records are discussed in **Section 4**. The EPBC Act has been further addressed in this assessment through:

- Field surveys for EPBC Act listed threatened biota and migratory species.
- Assessment of potential impacts on EPBC Act listed threatened species and migratory biota.
- Identification of suitable impact mitigation and environmental management measures for EPBC Act listed threatened species and migratory biota.

2.2 STATE LEGISLATION

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act forms the legal and policy platform for proposal assessment and approval in NSW and aims to '*encourage the proper management, development and conservation of natural and artificial resources*'. All development in NSW is assessed in accordance with the provisions of the EP&A Act and the EP&A Regulation 2000.

Development activities that require consent are assessed and determined in accordance with Part 4 of the EP&A Act. The determining authority for the project is Liverpool Plains Shire Council.

2.2.2 Biodiversity Conservation Act 2016

The NSW BC Act, the NSW *Biodiversity Conservation Regulation 2017* (NSW BC Regulation) and amendments to the NSW *Local Land Services Act 2013* (LLS Act) commenced on 25 August 2017. The legislation aims to deliver "a strategic approach to conservation in NSW whilst supporting improved farm productivity and sustainable development". The NSW BC Act repeals several pre-existing Acts, most notably the NSW *Threatened Species Conservation Act 1995*, the NSW *Nature Conservation Trust Act 2001* and the NSW *Native Vegetation Act 2003*.

In accordance with the NSW BC Act, entry into the Biodiversity Offsets Scheme (BOS) is not required for the proposed development due to the following:

- The proposed development is not deemed to be 'State Significant' under the NSW EP&A Act.
- The proposed development will not impact an Area of Outstanding Biodiversity Value (AOBV) as listed under Part 3 of the NSW BC Act.
- The proposed development is unlikely to cause a significant impact on a threatened species, population or ecological community, as listed under Schedules 1 and 2 of the NSW BC Act, as determined by application of a five-part-test of significance under Section 7.3 of the NSW BC Act.
- The proposed development will not impact areas mapped as having 'high biodiversity value' as indicated by the NSW Biodiversity Values Map (BV Map).

- The proposed development will mainly involve clearing of non-native vegetation and will not involve clearing of native vegetation that exceeds the BOS threshold for the site (1 ha threshold for a minimum lot size of 200 ha) as determined by the NSW BC regulation.

In consideration of the criteria listed above, a Biodiversity Development Assessment Report (BDAR) is not required for the proposed development. As part of the current assessment, threatened species and ecological communities as listed under the NSW BC Act that have previously been recorded within the locality (applying a 10 km buffer) were obtained from the on-line BioNet Atlas of NSW Wildlife (DPIE, 2020a). These records are discussed in **Section 4**.

The NSW BC Act has been further addressed in this assessment through:

- Field surveys to assess the presence of threatened species, populations and ecological communities, as listed under Schedules 1 and 2 of the NSW BC Act, within the Subject Site.
- Assessment of potential impacts threatened species, populations and ecological communities, as listed under Schedules 1 and 2 of the NSW BC Act, as determined by application of a five-part-test of significance under Section 7.3 of the NSW BC Act.
- Identification of suitable impact mitigation and environmental management measures.

2.2.3 Biosecurity Act 2015

The NSW *Biosecurity Act 2015* provides a streamlined statutory framework to protect the NSW economy, environment and community from the negative impact of pests, diseases and weeds. The primary objective of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

In NSW, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Weed species recorded within the site during the current investigation are discussed in **Section 4.2**.

2.2.4 National Parks and Wildlife Act 1974

The NSW *National Parks and Wildlife Act 1979* (NPWS Act) aims to conserve nature, objects, places or features (including biological diversity) of cultural value within the landscape. The Act also aims to foster public appreciation, understanding and enjoyment of nature and cultural heritage, and provides for the preservation and management of national parks, historic sites and certain other areas identified under the Act.

No areas of National Park estate occur within or adjacent to the Subject Site.

2.2.5 Water Management Act 2000

Controlled activities carried out in, on or under waterfront land are regulated by the NSW WM Act. The NSW Natural Resource Asset Regulator (NRAR) administers the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to 'waterfront land' as a consequence of carrying out the controlled activity. Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 m of the highest bank of the river, lake or estuary (NRAR, 2018). This means that a controlled activity approval must be obtained from the NRAR before commencing the activity.

Four first order watercourses are mapped within the immediate vicinity of the Subject Site, two to the north of the site, one along the site's south-eastern boundary, and one crossing the proposed site access to the south-west of the Subject Site (**Figure 2**). An assessment of indirect impacts of the proposed development on aquatic habitat and downstream aquatic habitats is provided in **Section 5.1.6**.

2.2.6 State Environmental Planning Policy (Koala Habitat Protection) 2019

State Environmental Planning Policy (Koala Habitat Protection) aims to encourage the conservation and management of areas of natural vegetation that provide habitat for Koalas to support a permanent free-living population over their present range and reverse the current trend of Koala population decline (DPIE 2020b).

A review of the SEPP spatial viewer indicates that the Subject Site is not mapped by the Koala Development Application Map including. No trees are proposed to be removed for this development therefore the Koala Habitat Protection SEPP is not applicable.

See **Section 4.9** for a summary of the Koala habitat assessment.

2.3 LOCAL PLANNING INSTRUMENTS

2.3.1 Liverpool Plains Shire Local Environmental Plan 2011

The Study Area is located within the Liverpool Plains Shire Council LGA. The Liverpool Plains Shire Local Environmental Plan 2011 (Liverpool Plains LEP, 2011) controls development within the Study Area through zoning and development controls. These controls are supported by the 2009 Liverpool Plains Shire Growth Management Study and Strategy and the Liverpool Plains Shire Development Control Plan (Liverpool Plains DCP, 2011), which applies to the Study Area given that it occurs within the Shire of Liverpool Plains.

2.3.2 Liverpool Plains Development Control Plan 2012

The Liverpool Plains Shire DCP supports the Liverpool Plains Shire LEP by providing additional detail and guidance on addressing environmental effects associated with development. In regard to environmental controls, the DCP contains the following provisions:

Section 4.2.1 Environmental Effects - The application documentation shall identify any potential environmental impacts of the development and demonstrate how they will be mitigated. These impacts may relate to:

- Traffic
- Flood liability
- Slope
- Construction impacts
- Solid and Liquid Waste
- Air quality (odour and pollution)
- Noise emissions
- Water quality
- Sustainability

The current assessment has been prepared in accordance with the Liverpool Plains LEP and Liverpool Plains DCP.

3. MATERIALS AND METHODS

3.1 DESKTOP ASSESSMENT

Existing information on the flora and fauna of the Subject Site and the locality, including relevant threatened biota was obtained from:

- Regional vegetation mapping: State Vegetation Type Map: Border Rivers Gwydir / Namoi Region Version 2.0. VIS_ID 4467 (DPIE, 2018)
- The BioNet Atlas of NSW Wildlife (DPIE, 2020a) for previous records of threatened species, populations and ecological communities (as listed under the BC Act) within a 5 km radius of the Subject Site (data retrieved 17/08/2020).
- The Department of the Environment and Energy (DoEE, 2020a) Protected Matters Search Tool, which involved a search for matters of national environmental significance within a 10 km radius of the Subject Site (conducted on 17/08/2020).
- Relevant published literature on threatened biota (see References).

The results of the database searches were used to compile a list of threatened species, populations and communities, as listed under the BC Act and EPBC Act that could potentially occur on the Subject Site, and their likelihood of occurrence.

3.2 FIELD SURVEY

3.2.1 Vegetation Assessment

A diurnal and nocturnal inspection of the Subject Site and surrounds was undertaken on 18 August 2020 to provide specific observations for this report.

Native vegetation types were identified based on dominant flora species present within each structural layer (i.e. canopy, shrub and ground layers). Exotic or highly modified native vegetation was defined based on structure and species composition. Boundaries of vegetation types and communities were marked with a hand-held GPS and mapped using geographical information system (GIS) software.

Vegetation types were assessed against identification criteria for State and Commonwealth listed threatened ecological communities (DoEE, 2020b; DPIE, 2020e). Vegetation and habitats were compared with descriptions provided in the BioNet Vegetation Classification to identify Plant Community Types (PCTs).

One 400 m² floristic plot/transects was sampled in accordance with Section 5.3.4 of the NSW Biodiversity Assessment Method (BAM) (OEH, 2017). Percentage cover and relative abundance was recorded for all plant species within each plot/transect. Plot/ transects were positioned to sample areas that were most representative of the floristic characteristics of each PCT.

Plant identification and nomenclature were based on species descriptions presented within The Flora of New South Wales Volumes 1 to 4 (Harden, 1993) and with reference to taxonomic updates in PlantNET - The Plant Information Network System of Botanic Gardens Trust, Sydney, Australia (Botanic Gardens Trust, 2020). The locations of all floristic plot/ transects are presented in **Figure 4**.

3.2.2 Fauna Habitat Assessment

The locations of any important habitat features, such as microbat roosting habitat, hollow-bearing trees, terrestrial refugia and nests/burrows were captured with a handheld Trimble device and photographed where appropriate.

Searches for potential habitat for threatened fauna species included but were not limited to:

- Koala feed trees.
- Foraging trees for threatened birds.
- Hollow-bearing trees.
- Potential roosts for microbats.
- Vegetated ponds, riparian vegetation and drainage lines for frogs and waterbirds.
- Woody debris, leaf litter and bush rock.

Diurnal opportunistic and incidental observations of fauna species were recorded during field surveys. These included opportunistic observation of fauna activity such as scats, tracks, burrows or other traces.

3.2.3 Microbat Surveys

Microbat surveys were conducted using high frequency call recorders called 'Anabats', which capture call signatures specific to each microbat species. Two Anabat Express detectors (Titley Scientific) was deployed for one night in the area of native vegetation within the south-western corner of the Subject Site to collect microbat call data (**Figure 4**).

Analysis of all bat calls was completed using zero-crossing analysis and AnalookW software by visually comparing the time-frequency graph and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from published guidelines. Call identification was also assisted by consulting distribution information for possible species (Churchill, 2009; Duffy, Lumsden, Caddle, Chick, & Newell, 2000; Pennay, Law, & Reinhold, 2004). No reference calls were collected during the survey.

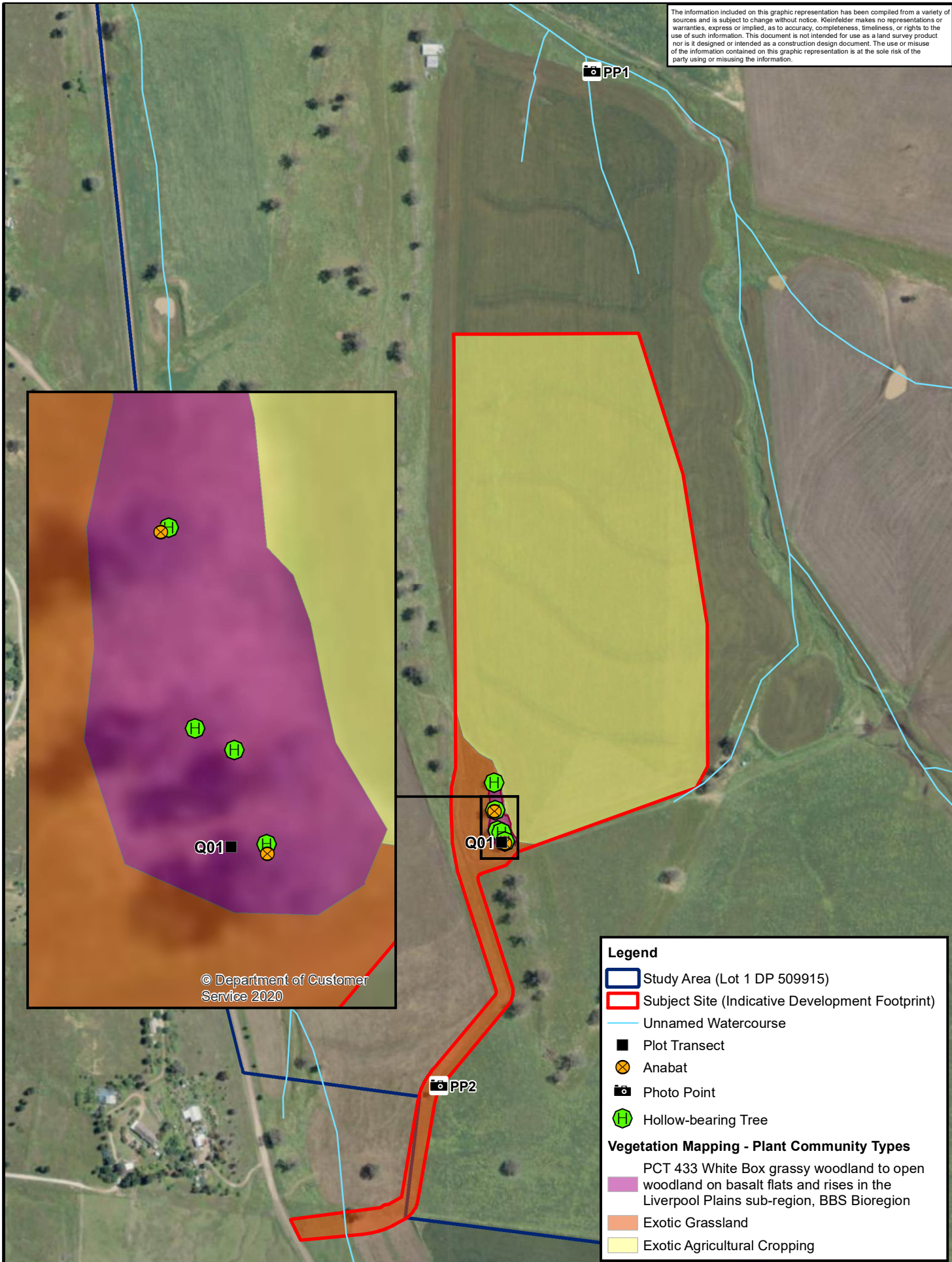
3.3 SURVEY LIMITATIONS

The survey techniques and survey effort applied for this study were commensurate with the nature and condition of the Subject Site. Due to these limitations, priority was given to habitat assessment for relevant threatened biota. A 'likelihood of occurrence' assessment was applied to all species previously recorded or predicted to occur within the locality based on State and Commonwealth information sources.

The field survey was undertaken during a 4.5-hour survey period by two ecologists (9 person hours total). While a moderate diversity of native and exotic flora species were recorded, a longer survey duration or multiple seasonal surveys would likely result in the detection of a greater diversity of species. The majority of the Subject Site is considered to be degraded and unsuitable for most threatened plant species known to occur in the locality; therefore, the survey effort that is recommended in *The NSW Guide to Surveying Threatened Plants* (OEH, 2016) is not considered to be applicable. Searches for threatened plants were focussed in areas where a greater diversity of flora was detected - such as the area of native vegetation within the south-western corner of the Subject Site, outside of agricultural cropping areas.

No nocturnal fauna surveys, fauna trapping or targeted surveys for cryptic fauna species was undertaken. No 'call playback' for arboreal fauna, large forest owl species or Koalas was conducted. Given the limited availability of native vegetation within the Subject Site, the survey effort was considered adequate to detect the fauna species most likely to be present.

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Legend

- Study Area (Lot 1 DP 509915)
- Subject Site (Indicative Development Footprint)
- Unnamed Watercourse
- Plot Transect
- Anabat
- Photo Point
- Hollow-bearing Tree

Vegetation Mapping - Plant Community Types

- PCT 433 White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region, BBS Bioregion
- Exotic Grassland
- Exotic Agricultural Cropping

0 25 50 100 150 200 250 Metres N KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT REFERENCE: 20211387 DATE DRAWN: 2020/09/08 13:02 Version 1 DRAWN BY: GJoyce DATA SOURCE: NSW DFSI - 2020 KDC - 2020 Daniel Lawless Drafting Service - 2018	Survey Effort and Vegetation Mapping Flora and Fauna Assessment Report Werris Creek Solar Farm 962 Black Gully Road, Werris Creek NSW Lot 1 DP 509915	FIGURE: 4
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4. RESULTS

4.1 PLANT DIVERSITY

A total of 29 plant species were identified during the assessment. These were comprised of 19 exotics and 10 natives. A complete list of flora species is presented in **Appendix 2**.

The majority of the exotic plant species were comprised of annual herbs and grasses associated with the agricultural grasslands. Native plant species were comprised mainly of annual herbs and grasses, and were restricted to the less disturbed areas around a small number of mature White Box *Eucalyptus albens* trees within the south-western corner of the Subject Site. Only one shrub species was recorded on site during the assessment, the Umbrella Wattle (*Acacia oswaldii*).

4.2 WEEDS

The groundcover within much of the Subject Site comprised of a monoculture crop of Barely Grass (*Hordeum spp.*). The south-western corner of the site, including the area around the remnant stand of mature White Box (*Eucalyptus albens*) trees was dominated by exotic plant species (See **Appendix 2** for complete flora list). Only one High Threat Exotic (HTE) was identified within the Subject Site during the assessment; *Bidens pilosa* (Cobblers Pegs).

Mitigation measures to reduce the impact of exotics, including High Threat Exotics identified within the Subject Site are presented in **Section 5.2.2.5**.

4.3 PLANT COMMUNITY TYPES

The Subject Site and surrounds have a history of intense agricultural development including the clearing of native vegetation and the cultivation of exotic pasture and crop species. The regional vegetation mapping (DPIE, 2018) indicates the entire Subject Site is comprised of Non-Native vegetation. The nearest areas of mapped native vegetation include an area of riparian vegetation to the north of the Subject Site and alongside Werris Creek mapped as *PCT 84 River Oak - Rough-barked Apple - red gum - box riparian tall woodland (wetland)* of

the Brigalow Belt South Bioregion and Nandewar Bioregion. Additionally, an area of PCT 433 White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region, BBS Bioregion, is mapped approximately 800 m to the east of the Subject Site.

The site assessment completed on the 18 August revealed that the majority of the Subject Site is comprised of Exotic Agricultural Cropping (Barely Grass *Hordeum spp.*) (11.32 ha), with smaller areas of Exotic Grassland (1.44 ha) and a patch of native vegetation including several mature White Box *Eucalyptus albens* trees (0.14 ha) (**Appendix 1, Plate 1 and Plate 2**), situated within in the south-western corner of the Subject Site (**Figure 5**).

The completion of one BAM plot (Q1) within the small the patch of native vegetation (**Appendix 1, Plate 1 and Plate 2**), found that the patch was characterised by a sparse canopy of White Box *Eucalyptus albens* trees, and an absent midstorey. The groundcover was dominated by non-native and exotic species including Couch (*Cynodon dactylon*), Redroot Amaranth (*Amaranthus retroflexus*), Small-flowered Mallow (*Malva parviflora*), Inkweed (*Phytolacca octandra*), Giant Mustard (*Rapistrum rugosum*), and Perennial Ryegrass (*Lolium perenne*). Native groundcover species were sparse but included a low cover of; Plains Grass (*Austrostipa aristiglumis*), *Aristida ramosa*, and *Panicum spp.*

A review of the BioNet Vegetation Classification indicates that this vegetation is commensurate with PCT 433 White Box grassy woodland to open woodland on basalt flats and rises in the Liverpool Plains sub-region, BBS Bioregion (White Box grassy woodland). However, as a result of historic clearing of native vegetation, cropping and grazing the patch is highly degraded, with many of the characteristic groundcover species heavily reduced or absent.

Note that the clearing of non-native vegetation for the proposed development does not trigger entry into the NSW BOS as described previously in **Section 2.2.2**.

4.4 THREATENED ECOLOGICAL COMMUNITIES

Biodiversity Conservation Act (BC Act)

The small area of White Box grassy woodland (PCT 433) found within the subject site represents *White Box Yellow Box Blakely's Red Gum Woodland* (Box-Gum Woodland), a 'critically endangered ecological community' (CEEC) under the BC Act. This identification is based on the Subject Sites location within the NSW Northern Tablelands, presence of

characteristic canopy species White Box (*Eucalyptus albens*), and the presence of a grassy (albeit reduced) understorey (DPIE 2020d). However, due to the heavily reduced nature of the native groundcover, dominated by exotic species, likely due to historic clearing of native vegetation, cropping and grazing within the patch this vegetation is considered to be a highly degraded form of Box-Gum Woodland CEEC (DPIE 2020d).

This vegetation will not be removed as part of the proposed development. Potential impacts of the proposed development on the have been assessed via an ‘assessment of significance’ pursuant to Section 7.3 of the BC Act.

Environment Protection and Conservation Act (EPBC Act)

The small area of White Box grassy woodland (PCT 433) found within the subject site does not constitute *White box – yellow box – Blakely’s red gum grassy woodlands and derived native grasslands* CEEC under the EPBC Act. This determination is based on the community not meeting key condition criteria, including; having a “predominantly native understorey” (requiring >50% native perennial groundcover), “at least 12 native non-grass understorey species” (only three recorded), and the presence of at least one “important species” (e.g. grazing-sensitive, regionally significant or uncommon species; such as Kangaroo Grass or orchids) (none recorded).

4.5 THREATENED FLORA SPECIES

No threatened flora species were identified within the Subject Site during the assessment. A search of the BioNet Atlas of NSW Wildlife (DPIE, 2020a) returned a list of eight threatened flora species that have previously been recorded within a 10 km radius of the Study Area;

- Ooline (*Cadellia pentastylis*),
- Bluegrass (*Dichanthium setosum*),
- Finger Panic Grass (*Digitaria porrecta*),
- *Euphrasia arguta*
- Native Milkwort (*Polygala linariifolia*),
- Leek-orchid (*Prasophyllum* sp. *Wybong*),
- Austral Toadflax (*Thesium australe*)
- *Tylophora linearis*

A detailed assessment of the likelihood of occurrence of all threatened species and endangered populations previously recorded or predicted to occur within the locality is provided in **Appendix 3**.

4.6 TERRESTRIAL FAUNA HABITAT

The assessment revealed that the majority of the Subject Site is comprised of Exotic Agricultural Cropping (Barely Grass *Hordeum spp.*) with an area of exotic grassland and a small patch of remnant native woodland within the south-western corner of the Subject Site (**Figure 5**).

At the time of the assessment leaf litter was high within the area of White Box grassy woodland, with minimal timber debris present across the site. The raised ridgeline contained low piles of rock which were presumed removed from the agricultural flats on either side.

The subject site was found to lack vegetation with a complex structure, shrubs and midstorey species were generally absent. The habitat is likely to support a low diversity of native fauna, including birds and mammal species common within agricultural landscapes.

Six mature White Box *Eucalyptus albens* occur within the subject site. Four of these trees are hollow bearing trees. One of the hollows was occupied by a hive of European Bees. None of the other hollows were observed to be occupied.

Two first order tributaries occur in the north of the subject site. They were observed to be shallow drainage lines which were cropped along with the surrounding area.

No dams occurred within the Subject Site. Four small dams occurred across the Study Area. A large dam mapped to the south of the subject site did not contain water.

In summary, the fauna habitat assessment determined the following:

- The mature trees within the subject site may provide marginal foraging and nesting habitat for several common native bird species.
- The exotic grasslands may provide foraging habitat for a range of native birds and terrestrial mammals such as macropods (Kangaroos and Wallabies).
- The denser areas of grassland and rock piles may provide refuge habitat for fauna groups such as amphibians, reptiles and small mammals.

- Exotic grasslands may provide hunting habitat for native predatory birds, such as Falcons, Kestrels and Large Forest Owls.
- Four hollow-bearing trees which contained a total of five hollows were identified within the subject site. These hollows were inspected from the ground and may be suitable nesting habitat for microchiropteran bats.

4.7 FAUNA SPECIES

Opportunistic fauna observations included sightings of common bird species such as the Australian Magpie, the Willie Wagtail, the Galah, the Eastern Rosella and the Whistling Kite. No reptile or amphibian species were detected.

Anabat analysis detected five species of microbat, including the following;

- Chocolate Wattled Bat (*Chalinolobus morio*)
- Eastern Free-tailed Bat (*Mormopterus ridei*)
- Little Forest Bat (*Vespadelus vulturnus*)
- South-eastern Free-tail Bat (*Mormopterus planiceps*)
- Gould's Wattled Bat (*Chalinolobus gouldii*)

4.8 THREATENED FAUNA SPECIES (BC ACT)

No threatened fauna species were detected within the Subject Site. A search of the BioNet Atlas of NSW Wildlife (DPIE, 2020a) returned a list of 22 threatened fauna species that have previously been recorded within 10 km of the Subject Site:

- Booroolong Frog (*Litoria booroolongensis*)
- Regent Honeyeater (*Anthochaera Phrygia*)
- Dusky Woodswallow (*Artamus cyanopterus cyanopterus*)
- Speckled Warbler (*Chthonicola sagittate*)
- Brown Treecreeper (*Climacteris picumnus victoriae*)
- Black Falcon (*Falco subniger*)
- Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*)
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*)
- Little Eagle (*Hieraaetus morphnoides*)
- Turquoise Parrot (*Neophema pulchella*)
- Blue-billed Duck (*Oxyura australis*)

- Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*)
- Australian Painted Snipe (*Rostratula australis*)
- Diamond Firetail (*Stagonopleura guttata*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Large Bent-winged Bat (*Miniopterus orianae oceanensis*)
- Koala (*Phascolarctos cinereus*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*)
- Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Eastern Cave Bat (*Vespadelus troughtoni*)

A “likelihood of occurrence” assessment (**Appendix 3**) determined that the habitat within the Subject Site is too degraded or unsuitable to support populations of the majority of these species listed above. However, areas of native vegetation within the Subject Site may provide marginally suitable habitat for one threatened species: the Yellow-bellied Sheath-tail-bat *Saccolaimus flaviventris*. Suitable nesting hollows were recorded within the mature White Box *Eucalyptus albens* trees located within the south-western corner of the Subject Site.

No trees will be removed as part of the proposed development, however potential impacts of the proposed development on the Yellow-bellied Sheath-tail-bat *Saccolaimus flaviventris* have been assessed via an ‘assessment of significance’ pursuant to Section 7.3 of the BC Act (**Appendix 5**).

4.9 KOALA HABITAT

Most of the subject site has been cleared for agricultural development. Isolated patches of mature trees were found to be comprised mainly of *Eucalyptus albens*, which is listed as a preferred Koala food tree species under Schedule 2 of the SEPP for Koala Habitat Protection (2019).

An assessment of Koala habitat within the subject site determined that no Highly Suitable Koala Habitat, or Core Koala Habitat is present. This is based on the following:

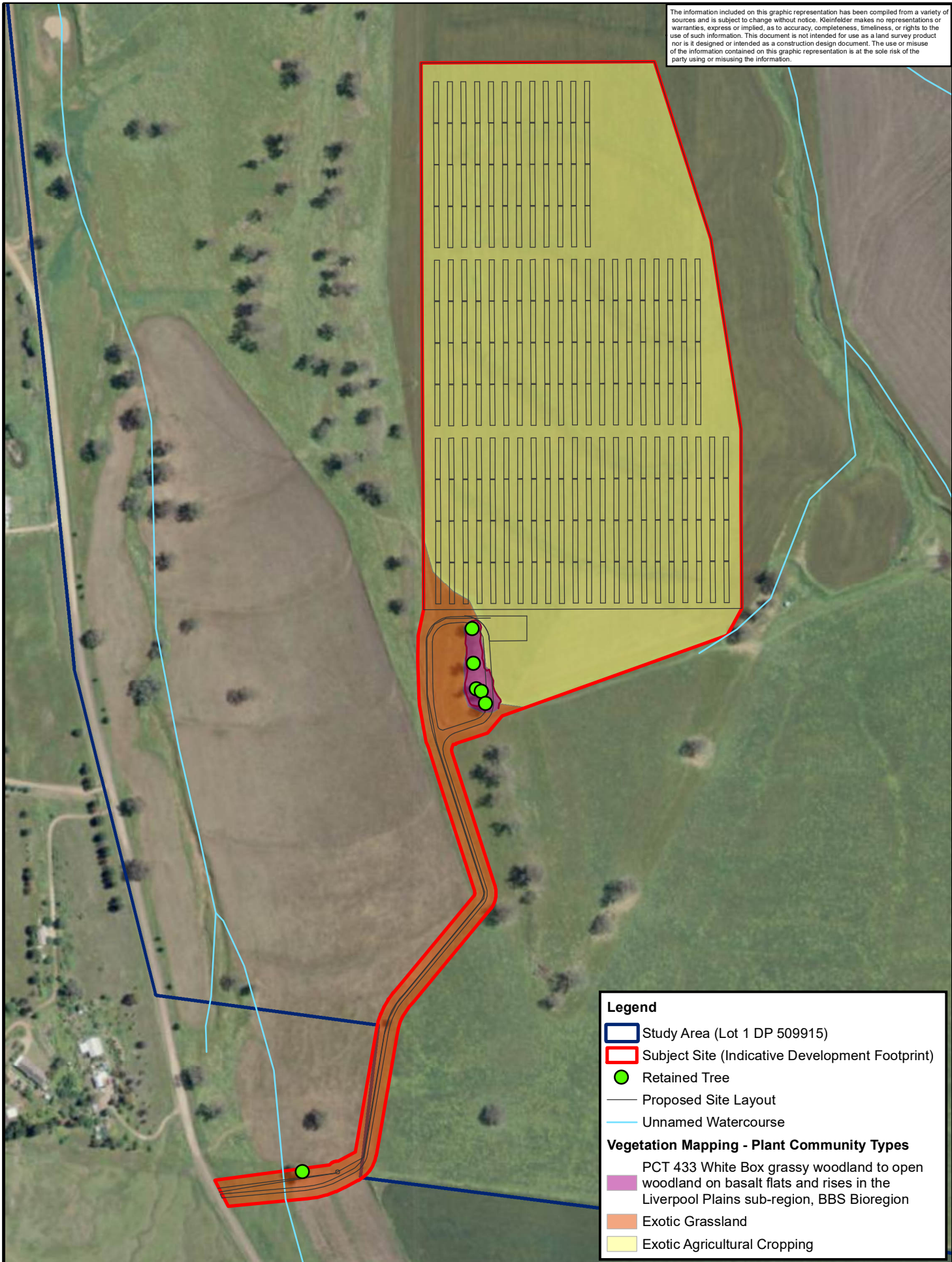
- No evidence of a resident population of Koalas was detected during the assessment (i.e. No Koala individuals, scats or scratch marks were identified).

- The Koala feed trees within the subject site are isolated in the landscape and are therefore unlikely to be fed upon by Koalas.

4.10 EPBC ACT PROTECTED MATTERS

A 'likelihood of occurrence' assessment was conducted for all threatened species and migratory species returned by the EPBC Protected Matters Search (**Appendix 4**). The habitats present within the Subject Site were considered to be too degraded for all species, with the exception of the Fork-tailed Swift (*Apus pacificus*) and the White-throated Needletail (*Hirundapus caudacutus*). These bird species may forage aerially over a very wide range of habitats including vegetated and non- vegetated areas. The proposed development will not remove habitat features considered to be important to these species. The extent of foraging habitat is likely to be unaffected.

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0 25 50 100 150 200 Metres KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT REFERENCE: 20211387 DATE DRAWN: 2020/09/08 13:07 Version 1 DRAWN BY: GJoyce DATA SOURCE: NSW DFSI - 2020 KDC - 2020 Daniel Lawless Drafting Service - 2018	Vegetation Impacts Flora and Fauna Assessment Report Werris Creek Solar Farm 962 Black Gully Road, Werris Creek NSW Lot 1 DP 509915	FIGURE: 5
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5. DISCUSSION

5.1 IMPACT ASSESSMENT

5.1.1 Removal of Native Vegetation

Most of the subject site is comprised of exotic agricultural cropping and exotic grasslands. No native vegetation will require removal

5.1.2 Impacts to Threatened Biota

In accordance with Section 7.3 of the BC Act, 'assessments of significance' have been prepared for all threatened species and ecological communities for which habitat was identified within the subject site. The assessments determined that the proposed development is unlikely to have a significant impact on any threatened biota listed under the BC Act. The findings of these assessments are summarised below.

5.1.3 Impacts to Threatened Ecological Communities

One Threatened Ecological Community (TEC) was identified within the Subject Site, the *White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions* was present on site (0.14 ha). Critically Endangered Ecological Community listed under the BC Act and the EPBC Act

The proposed development will not remove any areas of this community and is unlikely to affect the extent of the community such that its local occurrence would be placed at risk of extinction. Potential indirect impacts of the project include the following:

- The excavation of soil within the subject site has the potential to facilitate erosion and sediment movement in the locality. Runoff from the subject site has the potential to introduce toxicants or soil pathogens that could adversely affect the EEC.
- Machinery and vehicles may create dust that could adversely affect the vegetation within the EEC.

- The introduction of weeds (associated with machinery and equipment) has the potential to cause habitat degradation within the EEC.
- The introduction of chemicals has the potential to cause pollution.

Recommendations to reduce the potential for adverse environmental impacts are presented in **Section 5.2**

5.1.4 Impacts to Threatened Flora

No individuals of threatened flora species were recorded on site. The proposed development will require ground disturbance that would result in the removal of some exotic groundcover vegetation. Due to ongoing tillage and agricultural disturbance it is unlikely that the habitat to be disturbed is suitable or considered important for threatened plant species.

5.1.5 Impacts to Threatened Fauna

The following potential indirect impacts of the proposed development have been identified:

- Noise and lighting during the construction phase may cause minor disturbance to resident fauna within the locality and disrupt their natural behaviour.
- Night time lighting is not proposed; however, security lighting on sensors/timers may occur in the staging area. This may cause minor disruption to the natural behaviour of nocturnal fauna species such as microbats.
- Pollution such as chemical spills from construction machinery may have adverse effects on the water quality and biota within the constructed dams and downstream aquatic habitat.
- Ground disturbance by machinery during the construction phase may create dust and facilitate the movement of sediment. Sedimentation could adversely affect the water quality within downstream aquatic habitat.

Management measures are presented in **Section 5.2** to reduce the potential for these impacts.

5.1.6 Impacts to Aquatic Habitat

The proposed development has been designed to avoid where possible impacting the mapped waterways within the Study Area. One first order stream will be directly impacted by the proposed development. The first order stream which is crossed by the proposed access road

already has an existing vehicle access track crossing the stream at this location therefore further minor earthworks that may be required at this location will not modify the existing condition of this stream.

Potential indirect impacts include the following:

- The excavation of soil within the subject site during the construction phase has the potential to facilitate erosion and sediment movement. Runoff from the subject site has the potential to introduce nutrients and other toxins to downstream aquatic habitats.
- The introduction of chemicals such as fuels for vehicles and machinery during the construction phase has the potential to cause pollution to downstream aquatic habitat.

Recommendations to reduce the potential for adverse environmental impacts to aquatic habitat are presented in **Section 5.2**.

5.1.7 Cumulative Impacts

Cumulative impacts arise from the interaction of individual elements associated with the proposed development and the additive effects of other external projects. No other known projects within the locality are known to have relevance to this project that could exacerbate cumulative impacts.

5.2 IMPACT AMELIORATION

5.2.1 Avoidance Measures

Impacts on biodiversity values have been addressed through an iterative design process to avoid areas of higher biodiversity value within the Subject Site. The design of the solar panel array will ensure that most mature trees and native vegetation within the Subject Site will be retained following the development.

5.2.2 Mitigation Measures

5.2.2.1 Erosion Control

Mitigation measures to reduce soil erosion and pollutant run-off during construction activities should include:

- Installation of erosion and sediment control structures within 40 m of each drainage channel prior to any construction works.
- Regular inspection of erosion and sediment control measures, particularly following rainfall events to ensure their ongoing functionality.
- The immediate removal offsite of any excavated materials.
- Avoid stockpiling of materials adjacent to native vegetation, but instead use areas that are already cleared/ disturbed.
- Undertake maintenance of silt fences and other mitigation measures to isolate runoff.

5.2.2.2 Dust Control

Specific measures to minimise the generation of dust and associated impacts on adjacent natural environments should include:

- Setting maximum speed limits for all traffic within the Subject Site to limit dust generation.
- Use of a water tanker or similar to spray unpaved access tracks during the construction phase where required.
- Application of dust suppressants or covers on soil stockpiles.

5.2.2.3 Chemical Spills

Specific measures to minimise the potential for chemical spills and associated impacts on adjacent natural environments should include the following:

- All chemicals must be kept in clearly marked bunded areas.
- Regularly inspect vehicles and mechanical plant for leakage of fuel or oil.
- No re-fuelling of vehicles, washing of vehicles or maintenance of vehicles and plant to be undertaken within 20 m of natural drainage lines.

5.2.2.4 Vegetation Protection

The following recommendations are to be implemented during vegetation clearing:

- Areas of vegetation outside the development footprint are to be clearly demarcated to prevent accidental clearing or damage to vegetation during the construction phase.

5.2.2.5 Weed Management

The following recommendations are to be implemented during construction and operation to minimise the impact of weeds within the Subject Site:

- All vehicles should be cleaned prior to entering the site to prevent the introduction of new weed species,
- The site should be monitored during and after construction to ensure that Priority Weeds for the region and Weeds of National Significance are not introduced to the Subject Site.

5.2.3 Offset Provisions

As described previously in **Section 2.2.2**, entry into the Biodiversity Offsets Scheme (BOS) is not required for the proposed development.

5.3 CONCLUSION

The proposed development will only directly affect areas of exotic vegetation. The proposed development is unlikely to cause a significant impact to any threatened species, populations or ecological communities listed under the NSW BC Act. Entry into the NSW BOS is not triggered by the proposed development

No EPBC listed species, migratory species or important habitat for such entities was identified within the subject site. The assessment determined that impacts to MNES are unlikely; therefore, an EPBC referral to the Commonwealth Minister for the Environment is not recommended.

Avoidance and mitigation measures have been presented to reduce potential impacts to biodiversity values within the subject site and the environment.

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APPENDIX 1: SITE PHOTOGRAPHS



Plate 1: White Box grassy woodland remnant with mature White Box *Eucalyptus albens* and exotic groundcover,



Plate 2: White Box grassy woodland remnant with White Box *Eucalyptus albens* and exotic groundcover.

APPENDIX 2: FLORA SPECIES LIST

Table 1: Flora List

Growth Form	Plant Species	Plot 1	
		Cov.	Ab.
Exotic	<i>Amaranthus retroflexus</i>	25	300
Grass	<i>Aristida ramosa</i>	0.3	20
Exotic	<i>Aster subulatus</i>	0.2	10
Grass	<i>Austrostipa aristiglumis</i>	0.5	20
Tree	<i>Eucalyptus albens</i>	20	2
High threat Exotic	<i>Bidens pilosa</i>	0.2	5
Exotic	<i>Capsella bursa-pastoralis</i>	0.2	10
Exotic	<i>Cucumis myriocarpus</i>	1	20
Grass	<i>Cynodon dactylon</i>	20	100
Exotic	<i>Hordeum sp</i>	0.5	50
Grass	<i>Panicum spp.</i>	0.1	5
Forb	<i>Einadia nutans</i>	0.5	20
Exotic	<i>Erodium cicutarium</i>	0.3	5
Exotic	<i>Lolium perenne</i>	2	200
Exotic	<i>Medicago minima</i>	2	50
Forb	<i>Oxalis sp</i>	0.2	20
Exotic	<i>Phytolacca octandra</i>	10	400
Shrub	<i>Sclerolaena muricata</i> var. <i>semiglabra</i>	0.2	10
Exotic	<i>Silybum marianum</i>	0.2	5
Exotic	<i>Sisymbrium orientale</i>	2	100
Exotic	<i>Stachys arvensis</i>	0.2	20
Exotic	<i>Trifolium dubium</i>	0.2	20
Additional Plant Species identified within the Study Area			
Shrub	<i>Acacia oswaldii</i>		
Exotic	<i>Echium plantagineum</i>		
Exotic	<i>Malva parviflora</i>		
Forb	<i>Oxalis perrenans</i>		
Exotic	<i>Taraxicum officinale</i>		
Exotic	<i>Trifolium repens</i>		
Exotic	<i>Vicia sativa</i>		

Notes: High Threat exotics (HTE) are classified in accordance with the DPIE HTE List. Growth forms were classified in accordance with the DPIE growth forms data.

APPENDIX 3: THREATENED SPECIES 'LIKELIHOOD OF OCCURRENCE'

Table 2: Likelihood of occurrence

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
Flora								
1.	<i>Cadellia pentastylis</i> Ooline		V	-	PMST	Occurs along the western edge of the North West Slopes from north of Gunnedah to west of Tenterfield. Also occurs in Queensland. The natural range of Ooline is from 24°S to 30°S in the 500 to 750 mm per annum rainfall belt. Forms a closed or open canopy mixing with eucalypt and cypress pine species. Appears to flower spasmodically, during a general flowering period of October to January. Was not detected within the Subject Site during the assessment.	Low	Low
2.	<i>Dichanthium setosum</i> Bluegrass	V	V	-	PMST	Bluegrass occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending to northern Queensland. It is associated with heavy basaltic black soils and red-brown loams with clay subsoil. It is often found in moderately disturbed areas such as cleared woodland, grassy roadside remnants and highly disturbed pasture. (Often collected from disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched). Was not detected within the Subject Site during the assessment. No records of species within 10 km of Subject Site.	Low	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
3.	<i>Digitaria porrecta</i> Finger Panic Grass	E	-	4	BioNet	In NSW it is found on the North West Slopes and Plains, from near Moree south to Tambar Springs and from Tamworth to Coonabarabran. In NSW, the most frequently recorded associated tree species are <i>Eucalyptus albens</i> and <i>Acacia pendula</i>. Common associated grasses and forbs in NSW sites include <i>Austrostipa aristiglumis</i>, <i>Enteropogon acicularis</i>, <i>Cyperus bifax</i>, <i>Hibiscus trionum</i> and <i>Neptunia gracilis</i>. Was not detected within the Subject Site during the assessment. However, broadly suitable (albeit highly degraded) habitat is present within the remnant White Box grassy woodland patch	Low	Low
4.	<i>Euphrasia arguta</i>	CE	CE		PMST	Known from Nundle State Forest and adjacent private land, in New South Wales. The species is known from three locations in two areas approximately 14 km apart. Occur in eucalypt forest with a mixed grass and shrub understorey within Nundle State Forest. <i>Euphrasia arguta</i> has an annual habit and has been observed to die off over the winter months, with active growth and flowering occurring between January and April. Was not detected within the Subject Site during the assessment. Whilst the assessment was conducted outside of the flowering period, potential habitat is absent and no records exist within 10 km of the Subject Site.	Low	Low
5.	<i>Polygala linariifolia</i> Native Milkwort	E	-	1	BioNet	Found on the NSW north coast near Casino and Kyogle, and there is an isolated population in far western NSW near Weebah Gate, west of Hungerford. Sandy soils in dry eucalypt forest and woodland with a sparse understorey. Was not detected within the Subject Site during the assessment. However, broadly suitable (albeit highly degraded) habitat is present within the Subject Site.	Low	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
6.	<i>Prasophyllum</i> sp. Wybong Leek-orchid	-	CE	-	PMST	Endemic to NSW, it is known from near Ilford, Premer, Muswellbrook, Wybong, Yeoval, Inverell, Tenterfield, Currabubula and the Pilliga area. Most populations are small, although the Wybong population contains by far the largest number of individuals. Was not detected within the Subject Site during the assessment. The site is considered to be too degraded to support a population of this species.	Low	Low
7.	<i>Thesium australe</i> Austral Toadflax, Toadflax	V	V	-	PMST	Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast often found in association with Kangaroo Grass (<i>Themeda australis</i>). This species is a root parasite which takes water and some nutrient from other plants, especially Kangaroo Grass. No areas were found to be dominated by native grass species such as Kangaroo Grass. The species was not detected within the site during the assessment. The site is considered to be too degraded to support a population of this species. No records within 10 km of the Subject Site.	Low	Low
8.	<i>Tylophora linearis</i>		E	-	PMST	Majority of records occur in the central western region. Records from Goonoo, Pillaga West, Pillaga East, Bibblewindi, Cumbil and Eura State Forests, Coolbaggie NR, Goobang NP and Beni SCA. Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of <i>Eucalyptus fibrosa</i>, <i>Eucalyptus sideroxylon</i>, <i>Eucalyptus albens</i>, <i>Callitris endlicheri</i>, <i>Callitris glaucophylla</i> and <i>Allocasuarina luehmannii</i>. Was not detected within the Subject Site during the assessment. However, broadly suitable (albeit highly degraded) habitat is present within the Subject Site.	Low	Low
Threatened Ecological Communities								

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
1.	<i>Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions</i>	E	E	-	PMST	The definition of this community has been recently expanded in a NSW Scientific Determination to include woodlands in Cobar Penepine and Mulga Lands bioregions, in addition to the northern riverine plains in the Darling Riverine Plains and Brigalow Belt South bioregions. Abiotic factors that help define this community are that it typically occurs on grey self-mulching clays of periodically waterlogged floodplains, swamp margins, ephemeral wetlands and stream levees. Not Present on Subject Site.	Nil	Nil
2.	<i>Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia</i>	-	E	-	PMST	It mostly occurs from central NSW, through northern/central Victoria into eastern South Australia. The ecological community occurs in two forms, a grassy woodland form and as a derived native grassland. Not Present on Subject Site.	Nil	Nil
3.	<i>Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland</i>	-	CE	-	PMST	The ecological community generally occurs on flat to low slopes, of no more than 5% (or less than 1 degree) inclination. As slope increases, grassy woodlands dominated by trees such as <i>Acacia pendula</i> (weeping myall), <i>Eucalyptus coolabah</i> (coolibah), <i>E. populnea</i> (poplar box) or <i>E. melliodora</i> (yellow box) occur. The ground layer component of these woodlands may be similar to the grasslands but the soils are not generally the same cracking clays as on the plains. Not Present on Subject Site.	Nil	Nil

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
4.	<i>New England Peppermint (Eucalyptus nova-anglica)</i> Grassy Woodlands		CE			In NSW all sites are within the New England Tablelands. This community is or has been known to occur in the Armidale Dumaresq, Guyra, Inverell, Severn and Tenterfield Local Government Areas, but may occur elsewhere on the New England Tablelands. The community occurs primarily in valley flats subject to cold air drainage. Not Present on Subject Site.	Nil	Nil
5.	<i>Poplar Box Grassy Woodland on Alluvial Plains</i>		E			Grassy woodlands are widely distributed throughout the 'sheep-wheat belt', running from southern Queensland to central Victoria. They are characterised by a speciesrich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance of openly spaced trees, such as poplar/bimble box (<i>Eucalyptus populnea</i>). Not Present on Subject Site.	Nil	Nil
6.	<i>Weeping Myall Woodlands</i>	E	E			The Weeping Myall Woodlands generally occurs on the inland alluvial plains west of the Great Dividing Range in NSW and QLD. It occurs on flat areas, shallow depressions or gilgais on raised (relict) alluvial plains. <i>Acacia pendula</i> (weeping myall) trees are the dominant overstorey species in the Weeping Myall Woodlands ecological community. Not Present on Subject Site.	Nil	Nil
7.	<i>White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland</i>		CE			It occurs in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions. Characterised by the presence or prior occurrence of White Box, Yellow Box and/or Blakely's Red Gum and a generally grassy understorey. Present on Subject Site.	Present	Low
Amphibians								

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
1.	<i>Litoria booroolongensis</i> Booroolong Frog	E	E	-	PMST	The Booroolong Frog is restricted to NSW and north-eastern Victoria, predominantly along the western-flowing streams of the Great Dividing Range. Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. No suitable aquatic habitat is present within the Subject Site. No known records from the locality	Nil	Nil
Birds								
1.	<i>Anthochaera phrygia</i> Regent Honeyeater	CE	CE	2	PMST, BioNet	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low
2.	<i>Artamus cyanopterus</i> Dusky Woodswallow	V		4	BioNet	Prefers a variety of habitat including open forests/woodlands, timbered paddocks, coastal/ sub-inland scrubs, golf courses and roadside trees. Dusky woodswallows are widespread in eastern, southern and south western Australia. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low
3.	<i>Botaurus poiciloptilus</i> Australasian Bittern	E	E	-	PMST	Favors permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (<i>Typha spp.</i>) and spikerushes (<i>Eleocharis spp.</i>). No suitable aquatic habitat is present within the Subject Site.	Nil	Nil

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
4.	<i>Calidris ferruginea</i> Curlew Sandpiper	E	CE	-	PMST	It generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. No suitable estuarine habitat is present within the Subject Site.	Nil	Nil
5.	<i>Chthonicola sagittata</i> Speckled Warbler	V		6	BioNet	The Speckled Warbler has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low
6.	<i>Climacteris picumnus victoriae</i> Brown Treecreeper	V	-	6	BioNet	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (<i>Eucalyptus camaldulensis</i>) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
7.	<i>Erythrorhynchus radiatus</i> Red Goshawk	CE	V		PMST	Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, Melaleuca swamp forest and riparian Eucalyptus forest of coastal rivers. Marginal foraging habitat is present within the Subject Site.	Low	Low
8.	<i>Falco hypoleucos</i> Grey Falcon		V		PMST	The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Marginal foraging habitat is present within the Subject Site.	Low	Low
9.	<i>Falco subniger</i> Black Falcon	V	-	2	BioNet	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. The Black Falcon is found along tree-lined watercourses and in isolated woodlands, mainly in arid and semi-arid areas. Marginal foraging habitat is present within the Subject Site.	Low	Low
10.	<i>Grantiella picta</i> Painted Honeyeater	V	V		PMST	Inhabits Boree/ Weeping Myall (<i>Acacia pendula</i>), Brigalow (<i>A. harpophylla</i>) and Box-Gum Woodlands and Box-Ironbark Forests. This species is a specialist feeder on the fruits of mistletoes growing on woodland Eucalypts and Acacias. Prefers mistletoes of the genus <i>Amyema</i> . The Subject Site is comprised of agricultural lands that contain few native trees. No mistletoe was identified. The habitat is considered to be too degraded to support this species.	Low	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
11.	<i>Hirundapus caudacutus</i> White-throated Needletail		V		PMST	White-throated Needletails often occur in large numbers over eastern and northern Australia. White-throated Needletails are aerial birds and for a time it was commonly believed that they did not land while in Australia. It has now been observed that birds will roost in trees, and radio-tracking has since confirmed that this is a regular activity. Potential foraging habitat aurally over the site. Would not be affected by the proposed development.	Moderate	Low
12.	<i>Lathamus discolor</i> Swift Parrot	E	CE		PMST	Breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. In the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i>, Spotted Gum <i>Corymbia maculata</i>, Red Bloodwood <i>C. gummifera</i>, Forest Red Gum <i>E. tereticornis</i>, Mugga Ironbark <i>E. sideroxylon</i>, and White Box <i>E. albens</i>. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
13.	<i>Melanodryas cucullata</i> Hooded Robin (south-eastern form)	V	-	2	BioNet	The south-eastern form (subspecies <i>cucullata</i>) is found from Brisbane to Adelaide and throughout much of inland NSW. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low
14.	<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	V	-	3	BioNet	This species hunts for fish, turtles and sea snakes however will feed on carrion along the waterline. The White-bellied Sea-Eagle most often nests in trees 30 m above the ground. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest). The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low
15.	<i>Hieraaetus morphnoides</i> Little Eagle	V	-	1	BioNet	Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
16.	<i>Neophema pulchella</i> Turquoise Parrot	V	-	3	BioNet	Inhabits fringes of eucalypt woodlands, often adjacent to clearings, ridges and farmland creeks. Typically forages on the ground under trees. Distributed from southern Queensland to northern Victoria, extending from the coast to the western slopes of the Great Dividing Range. Nesting occurs from December to August in tree hollows. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low
17.	<i>Oxyura australis</i> Blue-billed Duck	V	-	1	Bionet	It is widespread in NSW, but most common in the southern Murray-Darling Basin area. The Blue-billed Duck prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. The species is completely aquatic, swimming low in the water along the edge of dense cover. It will fly if disturbed, but prefers to dive if approached. No suitable aquatic habitat is present within the Subject Site.	Low	Low
18.	<i>Pomatostomus temporalis temporalis</i> Grey-crowned Babbler (eastern subspecies)	V	-	3	BioNet	Inhabits Box-Gum woodlands on slopes, and Box-Cypress pine and Open-Box woodlands when on Alluvial plains. Distribution along most of the eastern side of Australia, particularly the western slopes of the Great Dividing Range. Breeding occurs between July and February. Several conspicuous dome-shaped nests are built and maintained in shrubs, sapling eucalypts or lower branches of larger eucalypts. Territories are usually around 10ha, but can be up to 50ha. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low
19.	<i>Rostratula australis</i> Australian Painted Snipe	E	E	1	PMST, BioNet	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. No suitable aquatic habitat is present within the Subject Site.	Nil	Nil

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
20.	<i>Stagonopleura guttata</i> Diamond Firetail	V		5	BioNet	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (<i>Eucalyptus pauciflora</i>) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Groups separate into small colonies to breed, between August and January. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Low	Low
Mammals								
1.	<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	V	V		PMST, BioNet	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (<i>Petrochelidon ariel</i>), frequenting low to mid-elevation dry open forest and woodland close to these features. No habitat is present within the Subject Site.	Nil	Nil
2.	<i>Dasyurus maculatus</i> (SE mainland population) Spot-tailed Quoll	V	E		PMST	This species has been recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Nil	Nil

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
3.	<i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle	V	-	11	BioNet	The species occurs on southeast coast and ranges. Prefers tall (>20m) and wet forest with dense understorey. Absent from small remnants, preferring continuous forest but can move through cleared landscapes and may forage in open areas. Roosts include hollow trunks of Eucalypts, underneath bark or in buildings. Forages in gaps and spaces within forest, with large foraging range (12km foraging movements recorded). No habitat is present within the Subject Site.	Nil	Nil
4.	<i>Miniopterus orianae oceanensis</i> Large Bent-winged Bat	V	-	7	BioNet	Generally occurs east of the Great Dividing Range along NSW coast. The species inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. No habitat is present within the Subject Site.	Low	Low
5.	<i>Nyctophilus corbeni</i> Corben's Long-eared Bat	V	V		PMST	Inhabits a variety of vegetation types, including Mallee, Bulloke <i>Allocasuarina leuhmanni</i> and box eucalypt dominated communities, but it is distinctly more common in box/ironbark/cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species. Not detected on Anabats.	Low	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
6.	<i>Petauroides volans</i> Greater Glider	-	v		PMST	Distribution levels are higher in regions of montane forest containing Manna Gum (<i>E. viminalis</i>) and mountain gum (<i>E. dalrympleana</i>, <i>E. obliqua</i>). Furthermore, the presence of <i>E. cypellocarpa</i> appears to improve the quality of habitat for the greater glider in forests dominated by <i>E. obliqua</i>. Another factor determining population density is elevation. Optimal levels are 845 m above sea level. They prefer overstorey basal areas in old-growth tree stands. No habitat is present within the Subject Site.	Nil	Nil
7.	<i>Petrogale penicillata</i> Brush-tailed Rock-wallaby	E	V		PMST	In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit. This species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browses on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. No rocky outcrops or cliffs are present within the Subject Site.	Low	Low
8.	<i>Phascolarctos cinereus</i> (combined populations of Qld, NSW and the ACT) Koala	V	V	7	PMST, BioNet	In NSW, Koalas occur along the coast, extending west to the Darling Riverine Plains and Mulga Lands bioregions in the north of the state; to the Cobar Peneplain bioregion in the centre of the state; and to the Riverina and eastern most parts of the Murray-Darling Depression bioregions in the south. The koala is found in a variety of forest types with suitable feed tree species. Preferred Koala feed trees (<i>Eucalyptus albens</i>) was identified within the Subject Site; however, these trees are isolated in the landscape and are unlikely to be fed upon by Koalas which prefer forest and woodland habitats.	Low	Low

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
9.	<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	1	PMST, BioNet	Occurs across a wide range of habitat types along the eastern seaboard of Australia, depending on food availability. Fruit from myrtaceous trees and rainforest trees form the major components of their diet. Marginal foraging habitat occurs within canopy gums; however, no camps were detected. The habitat is not considered to be important to this species.	Low	Low
10.	<i>Saccolaimus flaviventris</i> Yellow-bellied Sheath-tail-bat	V	-	6	BioNet	Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Roosts in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Suitable roosting and foraging habitat within Study Area. Known to the locality.	Moderate	Low
11.	<i>Scoteanax rueppellii</i> Greater Broad-nosed Bat	V		2	BioNet	The species is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks. No habitat is present within the Subject Site.	Nil	Nil
12.	<i>Vespadelus troughtoni</i> Eastern Cave Bat	V		19	BioNet	Very little is known about the biology of this uncommon species. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. Occasionally found along cliff-lines in wet eucalypt forest and rainforest. No habitat is present within the Subject Site.	Nil	Nil
Reptiles								

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
1.	<i>Aprasia parapulchella</i> Pink-tailed Worm-lizard, Pink-tailed Legless Lizard		V		PMST	The Pink-tailed Legless Lizard is only known from the Central and Southern Tablelands, and the South Western Slopes. Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (<i>Themeda australis</i>). No habitat is present within the Subject Site. Not known to the locality.	Nil	Nil
2.	<i>Delma impar</i> Striped Legless Lizard, Striped Snake-lizard		V		PMST	The Striped Legless Lizard occurs in the Southern Tablelands, the South West Slopes, the Upper Hunter and possibly on the Riverina. Found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component. No habitat is present within the Subject Site. Not known to the locality.	Nil	Nil
3.	<i>Uvidicolus sphyrrus</i> Border Thick-tailed Gecko	V	V		PMST	Found only on the tablelands and slopes of northern NSW and southern Queensland, reaching south to Tamworth and west to Moree. Most common in the granite country of the New England Tablelands. This species favours forest and woodland areas with boulders, rock slabs, fallen timber and deep leaf litter. Occupied sites often have a dense tree canopy that helps create a sparse understorey. The Subject Site is comprised of agricultural lands that contain few native trees. The habitat is considered to be too degraded to support this species.	Nil	Nil

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
4.	<i>Wollumbinia belli</i> Bell's Turtle	E	V		PMST	In NSW, currently found in four disjunct populations in the upper reaches of the Namoi, Gwydir and Border Rivers systems, on the escarpment of the North West Slopes. Shallow to deep pools in upper reaches or small tributaries of major rivers in granite country. Occupied pools are most commonly less than 3 m deep with rocky or sandy bottoms and patches of vegetation. No suitable aquatic habitat is present within the Subject Site.	Nil	Nil
Migratory Species								
1.	<i>Apus pacificus</i> Fork-tailed Swift	-	M		PMST	Forages aerially over a very wide range of habitats includes both vegetated and non- vegetated areas. Potential aerial foraging habitat above the Study Area.	Moderate	Low
2.	<i>Hirundapus caudacutus</i> White-throated Needle-tail	-	M		PMST	Forages in high open spaces over varied habitat types. Potential aerial foraging habitat above Study Area.	Moderate	Low
4.	<i>Motacilla flava</i> Yellow Wagtail	-	M		PMST	Typically inhabits inundated fields, saltmarsh and wetlands and occasionally coastal areas. No suitable habitat within the Study Area.	Nil	Low
5.	<i>Myiagra cyanoleuca</i> Satin Flycatcher	-	M		PMST	Found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests. No suitable habitat within the Study Area.	Nil	Low
6.	<i>Rhipidura rufifrons</i> Rufous Fantail	-	M		PMST	Found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. No suitable habitat within the Study Area.	Nil	Low

APPENDIX 4: EPBC ACT PROTECTED MATTERS SEARCH REPORT



EPBC Act Protected Matters Report

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

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

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 17/08/20 15:27:13

[Summary](#)

[Details](#)

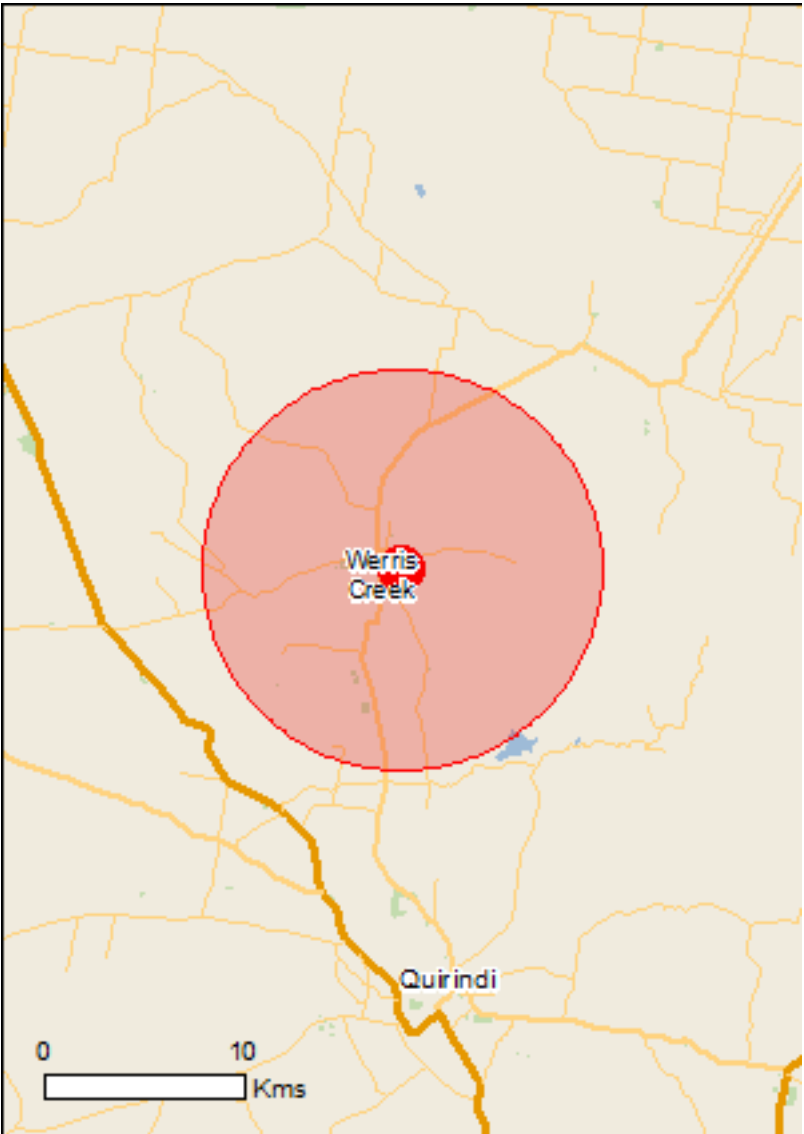
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

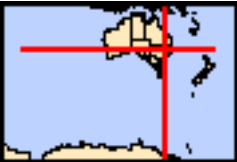
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

[Buffer: 10.0Km](#)



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	7
Listed Threatened Species:	28
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	17
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	29
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)		[Resource Information]
Name	Proximity	
Banrock station wetland complex	1000 - 1100km	
Riverland	900 - 1000km upstream	
The coorong, and lakes alexandrina and albert wetland	1100 - 1200km	

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

Name	Status	Type of Presence
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community may occur within area
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
New England Peppermint (Eucalyptus nova-anglica) Grassy Woodlands	Critically Endangered	Community may occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species	[Resource Information]
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Name	Status	Type of Presence
Birds		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Fish		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
Frogs		
Litoria booroolongensis Booroolong Frog [1844]	Endangered	Species or species habitat likely to occur within area
Mammals		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Plants		
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Euphrasia arguta [4325]	Critically Endangered	Species or species habitat may occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area
Reptiles		
Aprasia parapulchella Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area
Delma impar Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat may occur within area
Uvidicolus sphyrurus Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat likely to occur within area
Wollumbinia belli Bell's Turtle, Western Sawshelled Turtle, Namoi River Turtle, Bell's Saw-shelled Turtle [86071]	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species		
[Resource Information]		
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land

[Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Telstra Corporation Limited

Listed Marine Species

[Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area

Extra Information

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

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Lepus capensis Brown Hare [127]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Cylindropuntia spp. Prickly Pears [85131]		Species or species habitat likely to occur within area
Cytisus scoparius Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nassella neesiana Chilean Needle grass [67699]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-31.34702 150.65784

Acknowledgements

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

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

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

Please feel free to provide feedback via the [Contact Us](#) page.

APPENDIX 5: ASSESSMENT OF SIGNIFICANCE (PURSUANT TO SECTION 7.3 OF THE BC ACT)

6.1.1.1 Factors of Assessment - Biodiversity Conservation Act 2016

The five factors considered in the test of significance under s.7.3 of BC Act are shown in the table below. The tests of significance for all threatened species, populations and ecological communities considered likely to occur within the Study Area are provided in the proceeding sub-sections.

Table 3: Factors addressed in the assessment of significance

Factor	Species	Population	Ecological Community
in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.	X		
in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction			X
in relation to the habitat of a threatened species, population or ecological community: the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality	X		X
whether the proposed development or activity is likely to have an adverse effect any declared area of outstanding biodiversity value (either directly or indirectly).	NA	NA	NA
whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of, a key threatening process.	X	X	X

6.1.1.2 Threatened Ecological Communities

Table 4: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

Factors	Assessment of Significance
(b) (i) Extent	The subject site contains no areas that represent this community. The proposed development will not result in the removal of this community. This community exists off site in the immediate locality, in the road reserve adjacent to the eastern boundary of the Study Area. The proposed development will not remove any areas of the EEC and is unlikely to affect the extent of the EEC such that its local occurrence would be placed at risk of extinction.
(b) (ii) Composition	The vegetation to be retained adjacent to the Study Area is unlikely to be negatively impacted on from the proposal and will be retained in its current state. Therefore, its composition is unlikely to be altered as a result of the proposal, and it is unlikely to be placed at risk of local extinction due to composition alteration.
(c) (i) Habitat Removal	The proposal will not remove any areas of the EEC.
(c) (ii) Habitat Fragmentation	The areas of vegetation to be retained adjacent to the Study Area are already fragmented due to vegetation clearing for agricultural development. The proposed development will not increase habitat fragmentation as no vegetation from the EEC will be directly affected.
(c) (iii) Habitat importance	The EEC vegetation adjacent to the Study Area is considered to have moderate habitat importance due to its rarity in the locality.
(d) Effect on biodiversity value	There was no draft or final recovery plan in place at the time of this assessment. No threat abatement plans are relevant to the EEC.
(e) KTPs	The following KTPs are listed in order of their relevance to the EEC and the proposed development: • Invasion of native plant communities by exotic perennial grasses • Invasion and establishment of exotic vines and scramblers • Invasion of native plant communities by African Olive <i>Olea europaea</i> subsp. <i>cuspidata</i> (Wall. ex G. Don) Cif. • Infection of native plants by <i>Phytophthora cinnamomi</i> • Introduction and establishment of exotic rust fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae The proposal will not remove any areas of the EEC and indirect impacts will be mitigated.
Conclusion	As the proposal will remove no vegetation of the EEC, whilst retaining the vegetation in the adjacent road reserve, it is unlikely to have a significant impact on the EEC in the locality.

6.1.1.3 Threatened Fauna

Table 5: Yellow-bellied Sheath-tail-bat (*Saccolaimus flaviventris*)

Factors	Assessment of Significance
(a) Effect on life cycle	Yellow-bellied Sheath-tail-bat <i>Saccolaimus flaviventris</i> was not detected within the Subject Site during the assessment; however, records of the species occur in the locality and suitable roosting (hollows) and foraging habitat has been identified within the Subject Site. The proposed development will not involve the removal of native trees; hence, all potential roosting hollows will be retained. Given that no Yellow-bellied Sheath-tail-bats were detected during Anabat surveys conducted within the Subject Site and that all potential roosting hollows will be retained, it is unlikely that the proposed development will adversely affect the lifecycle of the species, such that a local population would be at risk of extinction.
(c) (i) Habitat Removal	All roosting habitat for the species will be retained within the Subject Site following the proposed development. The proposed development is unlikely to impact the species' foraging habitat adversely.
(c) (ii) Habitat Fragmentation	The proposed development will be confined within areas of exotic grassland and agricultural cropping and hence will not cause further habitat fragmentation for the species within the locality.
(c) (iii) Habitat importance	The proposed development will be confined within areas of exotic grassland and agricultural cropping, these treeless areas are considered suitable foraging habitat for the species. The proposed development is unlikely to adversely impact the suitability of this foraging habitat. Removal of this habitat is unlikely to put a local population at risk of extinction.
(d) Effect on biodiversity value	The proposed development does not occur within an Area of Outstanding Biodiversity Value (AOBV).
(e) KTP	Given that the Study Area is already a highly modified environment with few natural ecological features such as native vegetation and habitat values for fauna, the proposed development is likely to facilitate KTPs to a minor extent. only. Impacts are likely to be negligible.
Conclusion	The habitat for the species will be retained, the proposed development is considered unlikely to have a significant impact on this species in the locality.

APPENDIX 6: LICENSES AND PERMITS

Kleinfelder employees involved in the current study are licensed or approved under the *National Parks and Wildlife Act 1974* (License Number: SL100730, Expiry: 31 March 2021) and the *Animal Research Act 1985* to harm/trap/release protected native fauna and to pick for identification purposes native flora and to undertake fauna surveys.

Noise Assessment

Menz Solar Farm
Werris Creek, NSW.



Document Information

NOISE ASSESSMENT

Menz Solar Farm, Werris Creek NSW.

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APPENDIX A – GLOSSARY OF TERMS		

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been engaged by KDC Pty Ltd (KDC) to complete a Noise Assessment (NA) for the proposed Menz Gully Solar Farm near Werris Creek, NSW (the 'project'). This report presents the methodology and findings of the NA for the construction and operation of the project.

1.1 Purpose and Objectives

A NA is required as part of the Statement of Environmental Effects (SEE) to be submitted to the Liverpool Plains Shire Council (LPSC) as part of the Development Application (DA). The purpose of the NA is to quantify potential environmental noise emissions associated with the construction and operation of the project. Where impacts are identified, the assessment includes recommendations for potential noise mitigation and management measures.

1.2 Scope of the Assessment

The NA includes the following key tasks:

- review construction and operating activities to identify key noise generating plant, equipment, machinery or activities proposed to be undertaken as part of the project;
- identify the closest and/or potentially most affected receivers situated within the area of influence to the project;
- establish existing noise levels to determine project-specific construction Noise Management Levels (NMLs), and operational noise criteria;
- undertake 3D noise modelling to predict levels that may occur as a result of the construction and operation of the project at the closest and/or potentially most affected receivers;
- provide a comparison of predicted noise levels against relevant construction and operational criteria;
- assess the potential noise impacts associated with construction and operational aspects of the project; and
- provide feasible and reasonable noise mitigation and management measures, and monitoring options, where NMLs or operational criteria may be exceeded.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Project Description

2.1 Background

Wynergy Pty Ltd propose to construct and operate a 5 Megawatt (MW AC) solar farm using photovoltaic (PV) technology at approximately 0.5km east of Werris Creek, NSW.

2.2 Description of Proposed Construction Works

The project includes the installation of north-south aligned single axis trackers – which angle panels (2m x 1m) to follow the sun from east to west daily. An estimated 13,000 PV panels will be installed using a single axis tracking system, tilted +/- 60° along the north-south axis. The PV mounting structure would comprise steel posts driven up to approximately 1.5m below ground using a small pile driver. Additional support structures would be attached to the piles, which would then support the PV panels.

Earthworks will primarily involve trenching which is required for cabling of each PV array/module to inverters and a substation. Other minor earthworks would be completed for the preparation of the site and in most cases a concrete slab would be required to support the ancillary infrastructure. Most of the infrastructure would be pre-fabricated off-site, delivered and assembled on-site.

It is anticipated that the solar farm would be constructed in stages, with two to three stages in construction at any one time over a three month period during standard construction hours.

During construction and operational phases, all vehicles would access the project from the Black Gully Road onto a permanent access road to the project site.

During construction, traffic generated by the project would include employee and delivery vehicles. During the peak construction period, the daily traffic volume is expected to be up to eight heavy vehicles (semi-trailers or b-doubles) per day and 20 light commercial vehicles or equivalent mini buses for worker transport during the morning and afternoon peaks.

2.3 Description of Proposed Operation

PV infrastructure on site will comprise of groups of PV panels installed in rows running north to south. Each row of PV modules will rotate to track the sun across the sky from east to west each day. There is approximately 10m spacing between each row. The hub height of each tracker is 2m with the peak of the modules reaching a height of 4.1m when the array is fully tilted.

Electrical cabling would be attached beneath the modules and would connect the individual PV modules to each other. Inverters will be located centrally to groups of PV panels and connected to each other by underground cables. The PV modules will be on a single axis tracker system which will follow the sun and move in an east to west direction.

The project will be contained solely within the site as shown in **Figure 1**.

The project would operate 24 hours a day, 7 days a week, with no permanent staff on site. During operation, the PV panels would generate electricity which would be fed into the power grid via connection located on Black Gully Road. Key noise emissions from the operation of the project are associated with the inverter and transformer(s). It is noted that emissions from these sources are anticipated to be acoustically insignificant compared to ambient background noise levels at assessed receivers.

When required, maintenance activities will occur during standard working hours (except for emergencies) and are expected to include:

- panel cleaning;
- repairs or replacement of infrastructure, as required; and
- land management including mowing to control vegetation as required.

Typical noise sources associated with maintenance activities would include light vehicle movements on site and maintenance of equipment.

2.4 Potentially Sensitive Receivers

Using aerial photography, geospatial information and other project design information, MAC has identified the following potentially sensitive receivers that may be affected by noise from operation or construction activities and project related road traffic. **Table 1** presents a summary of receiver identification address and coordinates. These are reproduced visually in **Figure 1**.

Table 1 Noise Sensitive Receivers				
ID	Description/Address	Receiver Type	Coordinates (MGA 55)	
			Easting	Northing
R1	825 Black Gully Road	Residential	276986	6528430
R2	851 Black Gully Road	Residential	276917	6528442
R3	55 Gordon St	Residential	276744	6528354
R4	43 Kurrara Street	Residential	276546	6528165
R5	34 Gordon Street	Residential	276559	6528415
R6	73 Punyara Street	Residential	276725	6528576
R7	71 Punyara Street	Residential	276735	6528657
R8	853 Black Gully Road	Residential	276831	6528659
R9	35 Poole Street	Residential	276618	6528763
R10	873 Black Gully Road	Residential	276849	6528859
R11	49 Punyara Street	Residential	276765	6528915
R12	23 Anzac Parade	Residential	276757	6529194
R13	31 North Street	Residential	276766	6529456
R14	25 Russell Street	Residential	276624	6529793
R15	962 Black Gully Road	Residential	276863	6529805



FIGURE 1
Project Layout
MAC201147
Menz Solar Farm

KEY

- Receivers
- Panel Array
- Access Road
- Project Boundary



3 Noise Policy and Guidelines

This Noise Assessment has been conducted in accordance with the following key policy and guidelines:

- NSW Department of Environment and Climate Change, NSW Interim Construction Noise Guideline (ICNG), 2009;
- NSW Environment Protection Authority's (EPA's), Noise Policy for Industry (NPI), 2017;
- NSW Department of Environment, Climate Change and Water (DECCW), NSW Road Noise Policy (RNP), 2011; and
- US Federal Highways Administration/Environmental Protection Agency-Report 550/9-74-004 March (US FHWA).

The assessment has also considered and applied the following additional policy, guidelines and standards where relevant:

- Australian Standard AS 2436-2010 (R2016) (AS 2436) – Guide to Noise and Vibration Control on Construction, Demolition and Maintenance sites;
- Australian Standard AS 1055:2018 – Description and Measurement of Environmental Noise;
- Australian Standard AS /NZS IEC 61672.1-2019 (AS 61672) – Electro Acoustics - Sound Level Meters Specifications Monitoring; and
- Australian Standard AS IEC 60942-2004 (AS 60942) – Electroacoustics – Sound Calibrators.

3.1 Interim Construction Noise Guideline

The assessment and management of noise from construction work is completed with reference to the Interim Construction Noise Guideline (ICNG). The ICNG is specifically aimed at managing noise from construction work regulated by the EPA and is used to assist in setting statutory conditions in licences or other regulatory instruments. The types of construction regulated by the EPA under the POEO Act (1997), include construction, maintenance and renewal activities carried out by a public authority, such as road upgrades as described in Schedule 1 of the POEO Act.

The ICNG sets out procedures to identify and address the impact of construction noise on residences and other sensitive land uses. This section provides a summary of noise objectives that are applicable to the assessment.

The ICNG provides two methodologies for the assessment of construction noise emissions:

- Quantitative, which is suited to major construction projects with typical durations of more than three weeks; or
- Qualitative, which is suited to short term infrastructure maintenance (for projects with a typical duration of less than three weeks).

The methodology for a quantitative assessment requires a more complex approach, involving noise emission predictions from construction activities to the nearest relevant receivers. The qualitative assessment methodology is a more simplified approach that relies more on noise management strategies. This study has adopted a quantitative assessment approach.

The quantitative approach includes identification of potentially affected receivers, description of activities involved in the project, derivation of the construction noise management levels, quantification of potential noise impact at receivers and, provides management and mitigation recommendations. **Table 2** summarises the ICNG recommended standard hours for construction.

Table 2 Recommended Hours for Construction																									
Hour Commencing	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	
	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	PM	
Monday	OOH Period 2							Standard Hours												OOH Period 1					
Tuesday																									
Wednesday																									
Thursday																									
Friday																									
Saturday																									
Sunday								OOH Period 1																OOH Period 2	
Public Holiday																									

The recommended hours do not apply in the event of direction from police, or other relevant authorities, for safety reasons or where required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. Work conducted outside of standard hours are considered out of hours work (OOH). OOH periods are divided into two categories representing evening and night periods and cover the hours listed below:

Period 1 (evening/low risk period): Monday to Friday – 6pm to 10pm, Saturdays – 1pm to 6pm, Sundays – 8am to 6pm.

Period 2 (night/medium to high risk period): Monday to Friday – 10pm to 7am, Saturdays/Sundays – 6pm to 7am (8am on Sunday mornings).

There are no out of hours work proposed for this project.

3.1.1 Construction Noise Management Levels

Section 4 of the ICNG details the quantitative assessment method involving predicting noise levels and comparing them with the Noise Management Level (NML) and are important indicators of the potential level of construction noise impact. **Table 3** provides the ICNG recommended LAeq(15min) NMLs and how they are to be applied.

Table 3 Noise Management Levels		
Time of Day	Management Level LAeq(15min) ¹	How to Apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays.	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(15min) 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 work to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	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 work near schools, or mid-morning or mid-afternoon for work near residences; and if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours.	Noise affected RBL + 5dB	A strong justification would typically be required for work outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community.

Note 1: The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the construction noise management levels for noise assessment purposes and is the median of the ABL's.

3.1.2 Construction Sleep Disturbance

Section 4.3 of the ICNG (DECC, 2009) states that a sleep disturbance assessment is required where construction activities are planned to occur for more than two consecutive nights. Given that construction activities are anticipated to occur during standard construction hours, sleep disturbance has not been considered in this assessment.

3.2 Noise Policy for Industry

The EPA released the Noise Policy for Industry (NPI) in October 2017 which provides a process for establishing noise criteria for consents and licenses enabling the EPA to regulate noise emissions from scheduled premises under the Protection of the Environment Operations Act 1997.

The objectives of the NPI are to:

- provide noise criteria that is used to assess the change in both short term and long-term noise levels;
- provide a clear and consistent framework for assessing environmental noise impacts from industrial premises and industrial development proposals;
- promote the use of best-practice noise mitigation measures that are feasible and reasonable where potential impacts have been identified; and
- support a process to guide the determination of achievable noise limits for planning approvals and/or licences, considering the matters that must be considered under the relevant legislation (such as the economic and social benefits and impacts of industrial development).

The policy sets out a process for industrial noise management involving the following key steps:

1. Determine the Project Noise Trigger Levels (PNTLs) (ie criteria) for a development. These are the levels (criteria), above which noise management measures are required to be considered. They are derived by considering two factors: shorter-term intrusiveness due to changes in the noise environment; and maintaining the noise amenity of an area.
2. Predict or measure the noise levels produced by the development with regard to the presence of annoying noise characteristics and meteorological effects such as temperature inversions and wind.
3. Compare the predicted or measured noise level with the PNTL, assessing impacts and the need for noise mitigation and management measures.

4. Consider residual noise impacts - that is, where noise levels exceed the PNTLs after the application of feasible and reasonable noise mitigation measures. This may involve balancing economic, social and environmental costs and benefits from the proposed development against the noise impacts, including consultation with the affected community where impacts are expected to be significant.
5. Set statutory compliance levels that reflect the best achievable and agreed noise limits for the development.
6. Monitor and report environmental noise levels from the development.

3.2.1 Project Noise Trigger Levels (PNTL)

The policy sets out the procedure to determine the PNTLs relevant to an industrial development. The PNTL is the lower (ie, the more stringent) of the **Project Intrusiveness Noise Level (PINL)** and **Project Amenity Noise Level (PANL)** determined in accordance with Section 2.3 and Section 2.4 of the NPI.

3.2.2 Rating Background Level (RBL)

The Rating Background Level (RBL) is a determined parameter from noise monitoring and is used for assessment purposes. As per the NPI, the RBL is an overall single figure background level representing each assessment period (day, evening and night) over the noise monitoring period.

The RBLs relevant to the project are contained in **Section 4**.

3.2.3 Project Intrusiveness Noise Level (PINL)

The PINL ($L_{Aeq}(15min)$) is the RBL + 5dB and seeks to limit the degree of change a new noise source introduces to an existing environment.

3.2.4 Project Amenity Noise Level (PANL)

The PANL is relevant to a specific land use or locality. To limit continuing increases in intrusiveness levels, the ambient noise level within an area from all combined industrial sources should remain below the recommended amenity noise levels specified in Table 2.2 (of the NPI). The NPI defines two categories of amenity noise levels:

- **Amenity Noise Levels (ANL)** – are determined considering all current and future industrial noise within a receiver area; and
- **Project Amenity Noise Level (PANL)** – is the recommended level for a receiver area, specifically focusing on the project being assessed.

Additionally, Section 2.4 of the NPI states: “to ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows”:

PANL for new industrial developments = recommended **ANL** minus 5dBA.

The following exceptions apply when deriving the PANL:

- areas with high traffic noise levels;
- proposed developments in major industrial clusters;
- existing industrial noise and cumulative industrial noise effects; and
- greenfield sites.

The NPI states with respect to high traffic noise areas:

The level of transport noise, road traffic noise in particular, may be high enough to make noise from an industrial source effectively inaudible, even though the LAeq noise level from that industrial noise source may exceed the project amenity noise level. In such cases the project amenity noise level may be derived from the LAeq, period(traffic) minus 15 dB(A).

Where relevant this assessment has considered influences of traffic with respect to amenity noise levels (ie areas where existing traffic noise levels are 10dB greater than the recommended amenity noise level).

The recommended amenity noise levels as per Table 2.2 of the NPI are reproduced in **Table 4**.

Table 4 Amenity Criteria

Receiver Type	Noise Amenity Area	Time of day	Recommended amenity noise level dB LAeq(period)
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks.	See column 4	See column 4	5dB above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School Classroom	All	Noisiest 1-hour period when in use	35 (internal) 45 (external)
Hospital ward			
- internal	All	Noisiest 1-hour	35
- external	All	Noisiest 1-hour	50
Place of worship			
- internal	All	When in use	40
Passive Recreation	All	When in use	50
Active Recreation	All	When in use	55
Commercial premises	All	When in use	65
Industrial	All	When in use	70

Notes: The recommended amenity noise levels refer only to noise from industrial noise sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Types of receivers are defined as rural residential; suburban residential; urban residential; industrial interface; commercial; industrial – see Table 2.3 and Section 2.7 of the NPI.

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

3.2.5 Maximum Noise Assessment Trigger Level

The potential for sleep disturbance from maximum noise level events from a project during the night-time period needs to be considered. The NPI considers sleep disturbance to be both awakenings and disturbance to sleep stages.

Where night-time noise levels from a development/premises at a residential location exceed the following criteria, a detailed maximum noise level event assessment should be undertaken:

- LAeq(15min) 40dB or the prevailing RBL plus 5dBA, whichever is the greater, and/or
- LAmax 52dB or the prevailing RBL plus 15dBA, whichever is the greater.

A detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Other factors that may be important in assessing the impacts on sleep disturbance include:

- how often the events would occur;
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the development;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current understanding of effects of maximum noise level events at night.

3.3 Road Noise Policy

The road traffic noise criteria are provided in the Department of Environment, Climate Change and Water NSW (DECCW), Road Noise Policy (RNP), 2011. The policy sets out noise criteria applicable to different road classifications for the purpose of quantifying traffic noise impacts. Road noise criteria relevant to this assessment are presented in detail in **Section 4.3**.

4 Assessment Criteria

Background noise monitoring has not been conducted for this project and hence, the minimum applicable RBLs of 35dBA for the daytime period and 30dBA for the evening and night time periods have been adopted in accordance with NPI methodology.

4.1 Construction Noise Management Levels

Noise Management Levels (NMLs) for construction activities at all residential receivers are 45dB LAeq(15min) (RBL +10dB). Construction activities are planned for standard hours, however the relevant NML standard construction hours and out of hours periods are summarised in **Table 5**.

Table 5 Construction Noise Management Levels			
Location	Assessment Period ¹	RBL, dBA	NML dB LAeq(15min)
All Residential Receivers	Day (Standard Hours)	35	45 (RBL+10dBA)
	Evening (OOH Period 1)	30	35 (RBL+5dBA)
	Night (OOH Period 2)	30	35 (RBL+5dBA)

Note 1: See table 2 for Recommended Standard Hours for Construction.

4.2 Operational Noise Criteria

4.2.1 Project Intrusiveness Noise Levels

The PINLs for the project are presented in **Table 6** and have been determined based on the RBLs +5dBA.

Table 6 Project Intrusiveness Noise Levels			
Receiver	Period ¹	Adopted RBL dB LA90	PINL dB LAeq(15min)
All Residential Receivers	Day	35	40
	Evening	30	35
	Night	30	35

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.2.2 Project Amenity Noise Levels

The PANLs for receivers potentially affected by the project are presented in **Table 7**.

Table 7 Project Amenity Noise Levels					
Receiver Type	Noise Amenity Area	Assessment Period ¹	Recommended ANL dB LAeq(period) ²	PANL dB LAeq(period) ³	PANL dB LAeq(15min) ⁴
Residential	Rural	Day	50	50	53
		Evening	45	45	48
		Night	40	40	43

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: Recommended amenity noise levels as per Table 2.2 of the NPI.

Note 3: Project Amenity Noise Level equals the amenity noise level as there is no other industry in the area.

Note 4: Includes a +3dB adjustment to the amenity period level to convert to a fifteen-minute assessment period as per Section 2.2 of the NPI.

4.2.3 Project Noise Trigger Levels

The PNTLs are the lower of either the PINLs or the PANLs. **Table 8** presents the derivation of the PNTLs in accordance with the methodologies outlined in the NPI. For this assessment the night time PNTL of 35dB LAeq(15min) is the limiting criteria for residential receivers.

Table 8 Project Noise Trigger Levels				
Catchment	Assessment Period ¹	PINL dB LAeq(15min)	PANL dB LAeq(15min)	PNTL dB LAeq(15min)
Residential	Day	40	53	40
Receivers	Evening	35	48	35
(Rural)	Night	35	43	35

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.2.4 Maximum Noise Assessment Trigger Levels

The maximum noise trigger levels shown in **Table 9** are based on night time RBLs and trigger levels as per Section 2.5 of the NPI. The trigger levels will be applied to transient noise events that have the potential to cause sleep disturbance.

Table 9 Maximum Noise Assessment Trigger Levels			
Residential Receivers			
LAeq(15min)		LAmax	
40dB LAeq(15min) or RBL + 5dB		52dB LAmax or RBL + 15dB	
Trigger	40	Trigger	52
RBL +5dB	35	RBL +15dB	45
Highest	40	Highest	52

Note: Monday to Saturday; Night 10pm to 7am. On Sundays and Public Holidays; Night 10pm to 8pm.

Note: As per Section 2.5 of the NPI, the highest of the two criteria are adopted as the trigger level.

4.3 Road Traffic Noise Criteria

The road traffic noise criteria are provided in the RNP. For this assessment, the 'sub arterial road' category for Russell Street / Black Gully Road has been adopted. It is acknowledged that the functional classification of Russell Street / Black Gully Road is a 'Collector Road' in accordance with the Roads and Maritime Noise Criteria Guideline (April 2015). However, the Road Noise Policy does not provide separate noise criteria for Collector Roads, but applies the sub-arterial category to all roads that are not classified as local roads. The relevant road traffic noise criteria are provided in the RNP and are presented in **Table 10** for residential receivers.

Table 10 Road Traffic Noise Assessment Criteria for Residential Land Uses				
Road category	Road Name	Type of Project/Development	Assessment Criteria - dBA	
			Day (7am to 10pm)	Night (10pm to 7am)
Sub Arterial Roads	Russell Street/ Black Gully Road	Existing residences affected by additional traffic on existing arterial roads generated by land use developments	60dBA LAeq(15hr) external	55dBA LAeq(9hr) external
		Existing residences affected by additional traffic on existing local roads generated by land use developments	55dB LAeq(1hr) external	50dB LAeq(1hr) external

Note: For road noise assessments, the day period is from 7am to 10pm (ie there is no evening assessment period as there is with operational noise). Night is from 10pm to 7am.

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2dB, which is generally accepted as the threshold of perceptibility to a change in noise level.

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5 Modelling Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers for typical construction activities and operations. DGMR (iNoise, Version 2020) noise modelling software was used to quantify emissions from typical construction activities and operations. iNoise is a new intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers.

The model calculation method used to predict noise levels was in accordance with ISO 9613-1 'Acoustics - Attenuation of sound during propagation outdoors. Part 1: Calculation of the absorption of sound by the atmosphere' and ISO 9613-2 'Acoustics - Attenuation of sound during propagation outdoors. Part 2: General method of calculation'. The ISO 9613 standard from 1996 is the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

5.1 Construction Assessment Methodology

Construction activities are proposed to be progressive (trenching, piling and assembly) and will occur at several locations simultaneously. Noise emissions were modelled for the following four scenarios:

- earthworks for internal road and compound construction including the stripping of topsoil and unsuitable soil and the placement and compaction of road base;
- earthworks involving trenching for cabling;
- piling of panel supports; and
- assembly of the panels.

It is envisaged that all construction scenarios have the potential to occur simultaneously at up to three locations across the site. Noise emission data and assumptions used in this assessment are summarised in **Table 11**. All significant noise generating construction activities will be limited to standard construction hours. Where low intensity construction activities are required to be undertaken outside standard construction hours, such as cabling, minor assembly, use of hand tools etc, they will be managed such that they are not audible at any residential receivers.

Table 11 Construction Equipment Sound Power Levels, Lw dBA re 10⁻¹² W				
Noise Source/Item	Utilisation %	Quantity	Lw/Item	Total Lw
Trenching & Earthworks				
Backhoe	80	1	104	103
Light vehicle	25	2	76	73
Total – Trenching & Earthworks				103
Piling				
Piling Rig (hydraulic)	80	1	113	112
Tele-handler	75	1	106	105
Light vehicle	25	2	76	73
Total – Piling				113
Assembly				
Mobile Crane/HIAB	75	1	104	103
Tele-handler	75	1	106	105
Light vehicle	25	2	76	73
Hand tools/Power tools	50	1	102	99
Welder	50	1	105	102
Total – Assembly				109
Transport (on site)				
Heavy vehicle	40	1	104	101
Tele-handler	50	1	106	103
Total – Transport				105

5.2 Operational Assessment Methodology

5.2.1 Operational Noise Modelling Scenarios

For this assessment, noise predictions were modelled for a typical worst-case operational scenario over a 15-minute assessment period based on the assumptions and sound power levels in **Table 12**. Plant noise emission data used in modelling for this assessment were obtained from manufacturers data or the MAC database. Where relevant, modifying factors in accordance with Section 3.3 and Fact Sheet D of the NPI have been applied to calculations.

Table 12 Operational Equipment Sound Power Levels, Lw dBA re 10⁻¹² W

Noise Source/Item	Activity	Quantity	Lw/Item	Total Lw
PV Panel Tracking Motor ^{1,2}	All tracking motors in operation 1 minute per 15-minute period	216	78	85
185kW Inverter	Constant	27	80 ²	94
5MVA Transformer	Constant	1	87 ²	87

Note 1: Tracking motor is situated underneath the PV panel, -5dB attenuation applied to account for shielding provided by the panel.

Note 2: Modifying factor penalty of +5dB added for low frequency and +5dB added for tonality.

5.2.2 Meteorological Analysis

Noise emissions from industry can be significantly influenced by prevailing weather conditions. Light stable winds (<3m/s) and temperature inversions have the potential to increase noise at a receiver.

Fact Sheet D of the NPI provides two options when considering meteorological effects:

- adopt the noise enhancing conditions for all assessment periods without an assessment of how often the conditions occur – a conservative approach that considers a source to receiver winds for all receivers and F class temperature inversions with wind speeds up to 2m/s at night; or
- determine the significance of noise enhancing conditions. This requires assessing the significance of temperature inversions (F and G Class stability categories) for the night time period and the significance of light winds up to 3m/s for all assessment periods during stability categories other than E, F or G.

Given that a detailed analysis of the significance of noise enhancing conditions has not been undertaken the meteorological conditions adopted in the noise modelling assessment are summarised in **Table 13**.

Table 13 Modelled Site Specific Meteorological Parameters

Assessment Condition ¹	Temperature	Wind Speed / Direction	Relative Humidity	Stability Class
Day - Calm	20°C	3m/s all directions	50%	D
Evening - Calm	10°C	3m/s all directions	50%	D
Night - Calm	10°C	2m/s all directions	50%	F

Note 1: Day 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening 6pm to 10pm; Night - the remaining periods.

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6 Results

6.1 Construction Noise Results

Noise levels were predicted at each assessed receiver at a height of 1.5m above ground level for typical construction activities. **Table 14** summarises the maximum predicted noise level from each of the construction scenarios (trenching, piling and assembly) at each receiver.

Table 14 Predicted Construction Noise Levels					
Receiver ID	Description/Address	Predicted Noise Level Range dB LAeq(15min) ¹	Highest Predicted Noise Level dB LAeq(15min)	NML Standard Hours dB LAeq(15min)	Compliance Achieved
R1	825 Black Gully Road	22-47	47	45	No
R2	851 Black Gully Road	21-46	46	45	No
R3	55 Gordon St	12-36	36	45	Yes
R4	43 Kurrara Street	10-33	33	45	Yes
R5	34 Gordon Street	11-34	34	45	Yes
R6	73 Punyara Street	14-37	37	45	Yes
R7	71 Punyara Street	15-39	39	45	Yes
R8	853 Black Gully Road	19-44	44	45	Yes
R9	35 Poole Street	11-34	34	45	Yes
R10	873 Black Gully Road	25-50	50	45	No
R11	49 Punyara Street	23-48	48	45	No
R12	23 Anzac Parade	22-47	47	45	No
R13	31 North Street	20-46	46	45	No
R14	25 Russell Street	12-37	37	45	Yes
R15	962 Black Gully Road	14-39	39	45	Yes

Note 1: Noise levels from construction activities vary due to their location across the project site.

Noise levels at six (6) receivers (R1, R2, R10-R13) are expected to exceed the NMLs when works are nearest to those locations. The exceedance would be temporary, and of short duration and is primarily due to piling and earthworks activities when at their closest point to receivers.

6.2 Operational Noise Results

Noise levels were predicted at each assessed receiver at a height of 1.5m above ground level during worst case noise enhancing meteorological conditions. **Table 15** summarises the predicted operational noise levels which are demonstrated to comply with the PNTLs at all residential receivers.

Table 15 Predicted Operational Noise Levels				
Receiver ID	Description/Address	Predicted Noise Level dB LAeq(15min)	Limiting Night PNTL dB LAeq(15min)	Compliance Achieved
R1	825 Black Gully Road	<30	35	Yes
R2	851 Black Gully Road	<30	35	Yes
R3	55 Gordon St	<30	35	Yes
R4	43 Kurrara Street	<30	35	Yes
R5	34 Gordon Street	<30	35	Yes
R6	73 Punyara Street	<30	35	Yes
R7	71 Punyara Street	<30	35	Yes
R8	853 Black Gully Road	<30	35	Yes
R9	35 Poole Street	<30	35	Yes
R10	873 Black Gully Road	30	35	Yes
R11	49 Punyara Street	<30	35	Yes
R12	23 Anzac Parade	<30	35	Yes
R13	31 North Street	<30	35	Yes
R14	25 Russell Street	<30	35	Yes
R15	962 Black Gully Road	<30	35	Yes

6.3 Maximum Noise Level Assessment - Operations

A detailed maximum noise level assessment is not required as predicted noise levels for night time operations do not exceed the maximum noise level trigger level of 40dB LAeq(15min) and there are no operational noise sources that could be considered to cause maximum noise events.

6.4 Road Traffic Noise Assessment

Access to the site will be directly off Russell Street / Black Gully Road which is the major transport route for all vehicles to access the project site. During construction, traffic generated by the project includes employee/subcontractor and delivery vehicles. The traffic volume over a typical day for standard construction hours is expected to be up to four heavy vehicles (semi-trailers or B-doubles) per hour and 20 light commercial vehicles (or equivalent mini buses) for worker transport during the morning and afternoon peak hour periods.

Predicted noise levels from project related construction traffic at 20m from the road to represent the potential for receivers situated close to the Russell Street / Black Gully Road and other local roads, between the project site and the township, has been completed using the United States (US) Environment Protection Agency's road traffic calculation method and results are presented in **Table 16**. The US FHWA road traffic calculation method (based on equations in Appendix A-13) was used to predict the LAeq noise levels from construction vehicles travelling past receivers along public roads. This method is an internationally accepted theoretical traffic noise prediction model and is ideal for calculating road traffic noise where relatively small traffic flows are encountered.

Table 16 Predicted Construction Road Traffic Noise Levels

Road Name	Offset Distance to Receiver	Predicted Noise Level	RTN Criteria	Compliance Achieved
Black Gully Road	20m	44dB LAeq(15hr)	60dBA LAeq(15hr)	Yes
Local Roads	20m	49dB LAeq(15hr)	55dBA LAeq(15hr)	Yes

Results demonstrate that project construction traffic noise levels would comply with the relevant RNP criteria.

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7 Recommendations

7.1 Construction Noise Recommendations

It is noted that construction noise emissions are expected to exceed the relevant NMLs at several nearest receivers to the project. Recommendations for consideration during construction activities to reduce emissions to the surrounding community for this project may include:

- a construction noise management protocol to minimise noise emissions, manage out of hours (minor) works to be inaudible, and to respond to potential concerns from the community;
- where possible use localised mobile screens or construction hoarding around plant to act as barriers between construction works and receivers, particularly where equipment is near the site boundary and/or a residential receiver including areas in constant or regular use (eg unloading and laydown areas);
- operating plant in a conservative manner (no over-revving), shutdown when not in use, and be parked/started at farthest point from relevant assessment locations;
- selection of the quietest suitable machinery available for each activity;
- avoidance of noisy plant/machinery working simultaneously where practicable;
- minimise impact noise wherever possible;
- utilise a broadband reverse alarm in lieu of the traditional high frequency type reverse alarm;
- provide toolbox meetings, training and education to drivers and contractors visiting the site during construction so they are aware of the location of noise sensitive receivers and to be cognisant of any noise generating activities;
- signage is to be placed at the front entrance advising truck drivers of their requirement to minimise noise both on and off-site; and
- utilise project related community consultation forums to notify residences within close proximity of the site with project progress, proposed/upcoming potentially noise generating works, its duration and nature and complaint procedure.

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8 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has been engaged by KDC Pty Ltd (KDC) to complete a Noise Assessment (NA) for the proposed Menz Solar Farm near Werris Creek, NSW. The assessment has quantified potential noise emissions associated with the construction and operation of the project.

The results of the NA demonstrate that construction noise levels have potential to exceed relevant construction NMLs at several nearest receivers in proximity of the project. Recommendations have been provided to minimise the potential noise impacts from construction, albeit of a temporary nature during the daytime over a three month construction period.

Operational noise levels satisfy the NPI PNTLs for assessed receivers.

Additionally, the NA demonstrates that the road noise criteria as specified in the RNP will be satisfied at receivers on the proposed transport route.

Based on the NA results, there are no noise related issues which would prevent the approval of the project. The results of the assessment shows compliance with the relevant operational and road noise criteria. Accordingly, no additional ameliorative measures will be required.

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Appendix A – Glossary of Terms

A number of technical terms have been used in this report and are explained in Table A1.

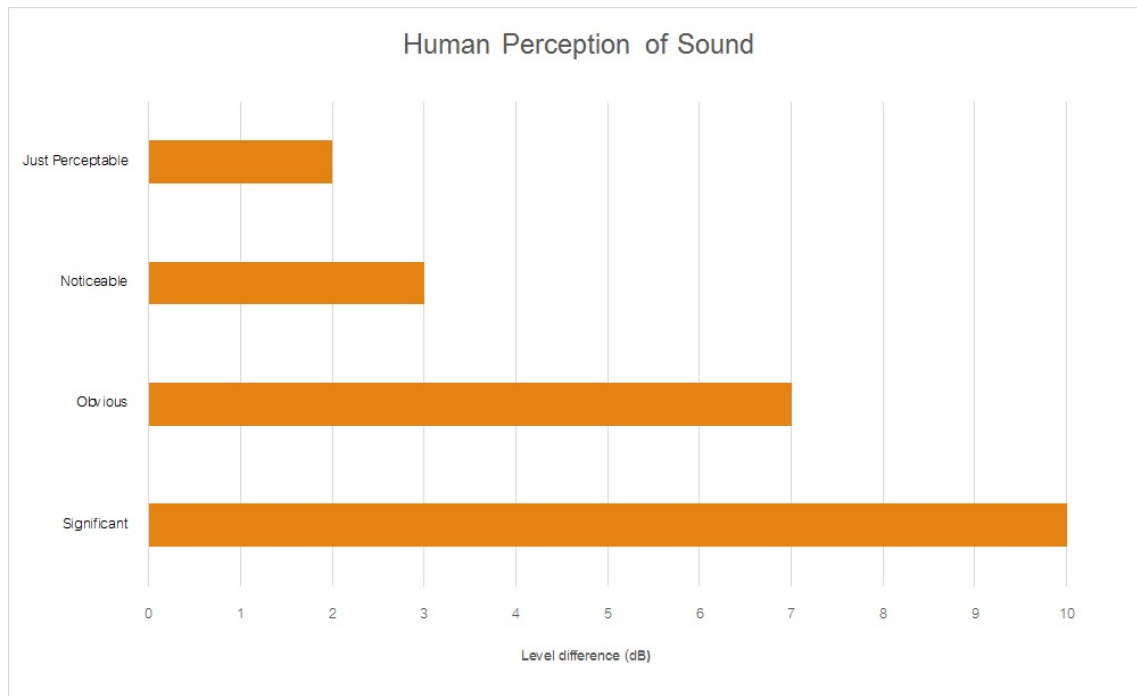
Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Ambient Noise	The noise associated with a given environment. Typically, a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmx	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : $= 10 \cdot \log_{10} (W/W_0)$ Where: W is the sound power in watts and W₀ is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA

Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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Menz Solar Farm Reflectivity Report Werris Creek, NSW

Rev	Date	Author	Reviewed By	Approved by	Remarks
A	24/09/2020	Ben Wynn	Bronwyn Brennan	Shonelle Gleeson-Willey	
1	28/9/2020	Ben Wynn	Shonelle Gleeson-Willey	Shonelle Gleeson-Willey	Amended as per comments.
B	17/2/2021	Ben Wynn	Ben Wynn	Ben Wynn	Adjusted following objection response request listed as 1)b in RFI from LPSC on Jan 11/21

This reflectivity report has been prepared for Menz Solar Farm Pty Ltd; and has been reviewed by Shonelle Wiley-Gleeson (BaAppSc(EMT), MEM, CEnvP, ISAP, CPESC) of Moss Environmental Pty Ltd. The report is a high-level assessment and draws on the reflectivity reporting for other similar 5MW solar farm projects in NSW, namely the Manilla 5MW, Country Road Warral 5MW and Kootingal 5MW Solar Farms currently lodged with Tamworth Regional Council.

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2. Executive Summary

This report has evaluated the potential glare affects from the proposed Menz solar farm project located 500m East of the Werris Creek township in relation to the:

- Aviation Sector
- Motorists and Pedestrians
- Nearby residences; and
- Industrial and agricultural machinery operators

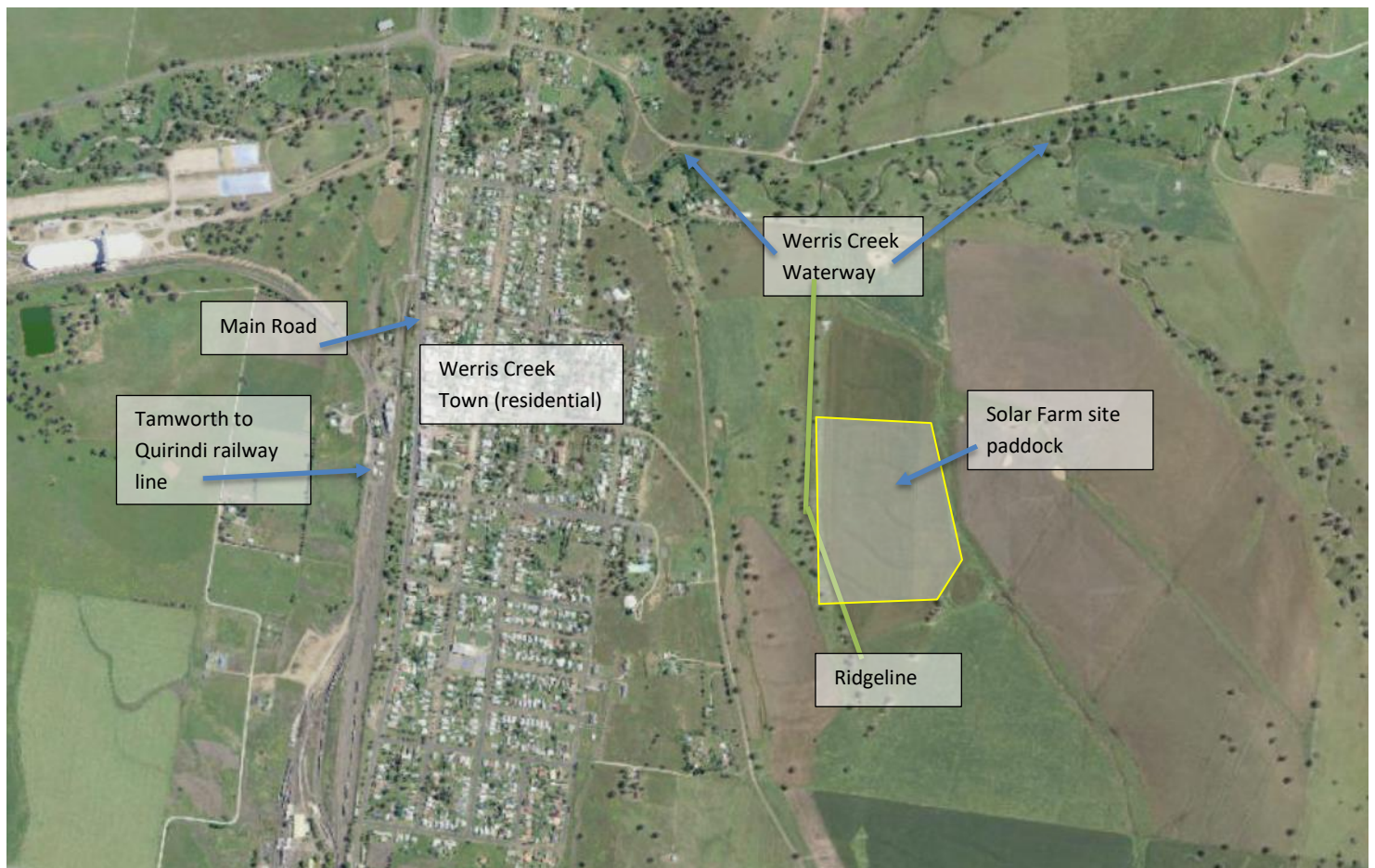
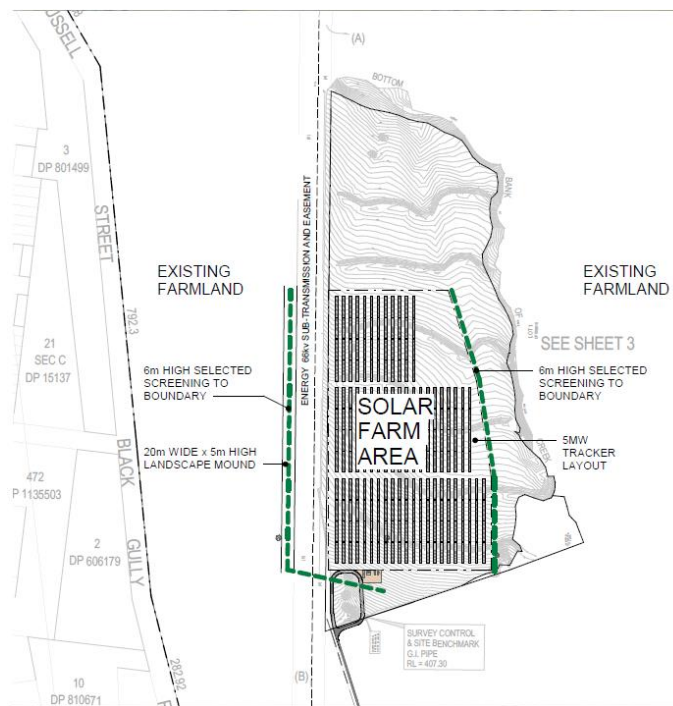
In all cases, the present study has found that the potential for adverse glare from the proposed facility will be negligible to nil. Factors contributing to the findings include:

- The physical properties and characteristics of photovoltaic (pv) solar panels
- The choice of horizontal single axis tracking mounting system
- The implementation of the landscape plan, which, when executed in accordance with the Liverpool Plains Development Control Plan, will also reduce and diffuse 'line of sight' through to the solar farm for most receivers

24/7 lighting is not proposed for the facility for operational purposes. Should 24/7 lighting be incorporated into the facility in the future, there will be negligible impact assuming the lighting design is in accordance with AS 4282-1997 *Control of the Obtrusive Effect of Outdoor Lighting*. This will also address any potential adverse eco-lighting issues in relation to nocturnal fauna within and surrounding the site.

3. Proposed Development

The proposed development is a 5MW agrivoltaic solar farm which includes solar panel trackers, off-loading, energy management, storage and car parking areas, plus power lines running under the proposed access track to connect with an 11kv feeder emanating from the nearby substation. Ground treatment under the panels will remain as improved regenerative style pasture and is to be grazed by livestock.



4. Site - General Description

The project site is located on Lot 1 DP 509915, 962 Black Gully Road, Werris Creek NSW.

The development proposal consists of 216 solar trackers spread over approximately 8ha within a 15ha parcel of existing grazing and cropping landscape, located in a central position of Lot 1 DP 509915, East of Black Gully Road which traverses the eastern boundary of the township of Werris Creek.

The proposed solar farm has been positioned to take advantage of a natural ridgeline on the western border. The ridge, 5-8m higher than the solar farm topography, is already home to approximately 40 mature *Eucalyptus albens* (Whitebox) averaging 15m high. When the proposed indigenous vegetation buffer of shrubbery to 6m high is completed, it will provide excellent screening for those residences that may currently have sporadic views of the solar farm from the eastern side of Werris Creek; with eastern views across Lot 1.

The eastern boundary of the proposed solar farm will also be screened with indigenous shrubbery to 6m. The native flora slated for the eastern vegetative screening will also act as a soil binder, helping to maintain erosion control of riparian zone of black gully which provides a geographical feature defining the eastern boundary of the proposed site.

The solar farm's southern boundary (and subsequent 'aspect view from the south'; from the Essential Energy substation on Black Gully Road) takes advantage of existing vegetation atop a ridgeline which forms a partial screening buffer.

The northern boundary is proposed to retain its 'existing pasture' characteristics with no screening. The topography of the solar farm runs down from south to north by approximately 12m; down to 'Werris Creek' waterway which is adequately vegetated as a screen to visually buffer existing dwellings to the Northwest and Northeast; which have zero 'line-of-sight' of the proposed development.

Glen Alpine Road on the northern side of Werris Creek is negligibly affected by the proposed solar farm, with the extensively vegetated Werris Creek providing a screening buffer for vehicles as they traverse the route.

4.1. Topography

The site topography slopes from Southwest to the Northeast; and falls approximately five to fifteen metres; generally, away from the ridgeline on the western side of the farm down to the gully on the eastern side of the farm.

4.2. Surrounding landscape character

The surrounding landscape character is rural, consisting of open grazing and cropping land, ridges, gullies, a central (Werris Creek) waterway sits as a 'bottom-point' reference with rolling topography of the valley. Scattered trees and vegetated areas are also located in the immediate surrounding.

The closest dwellings are those located on the east of Werris Creek township, approximately 400m away.

The closest located Rural homesteads are located some distance away, with the closest being the Lessor/landholder approximately 750m away to the Northwest; with views of the solar farm obscured by the western boundary ridgeline. Two more rural homesteads are located 1.4km away to the Northeast. Their views of the project are also obscured by natural topography and existing vegetation screens surrounding their premises.

5. Infrastructure – the 2P Single Axis Tracker

The Menz Agrivoltaic solar farm will use ground-mounted 2x panel 'single axis tracker' as its primary infrastructure. 2P horizontal tracking systems necessitate wider rows (10-12m) between trackers, providing for a continued ability to access and use the land for agricultural productivity; enabling co-location of energy generation and farming industry.

The solar farm will consist of 216 trackers aligned north/south. Each tracker is 32.7m long with arrays that are 4.1m x 30.5m. Each array tracks the sun from east to west daily through a 120 degree range of motion.

The array field (see figure 1) is positioned (predominantly) behind a ridgeline immediately to the west of the proposed solar farm; approximately 400m from Black Gully Road and 420m from the first residential receiver.

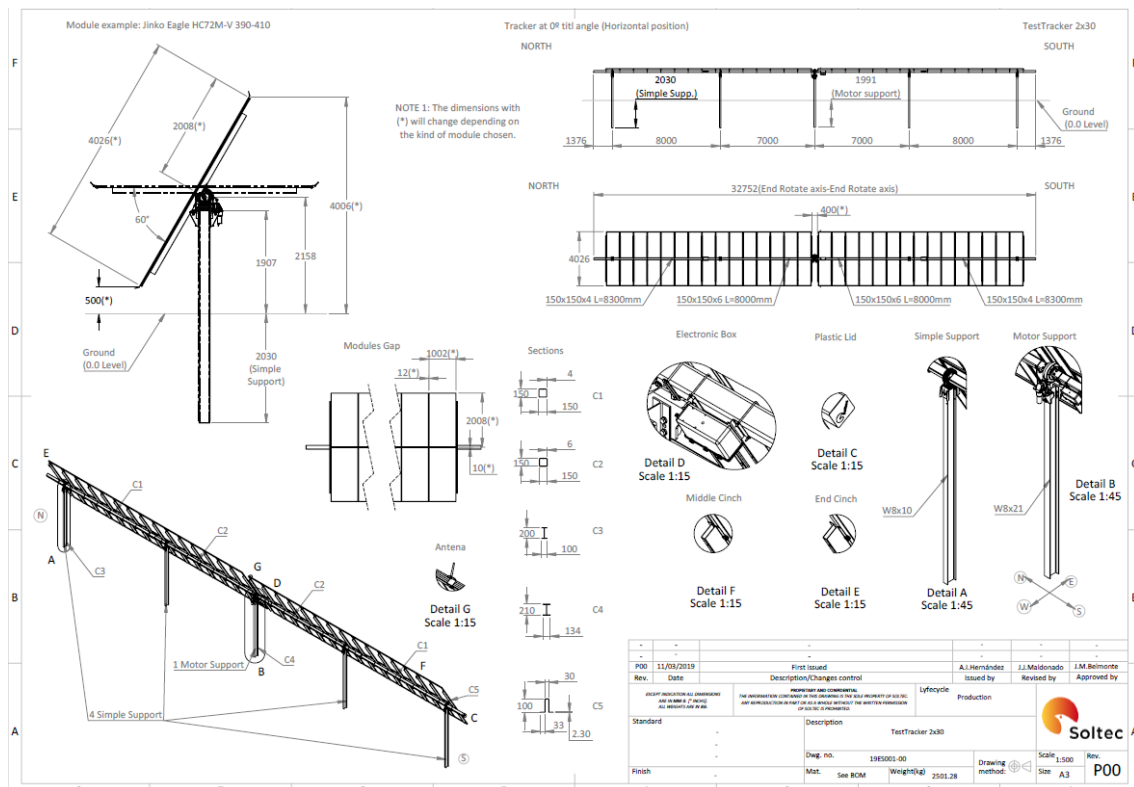


Figure 3: The Soltec SF7 2P SAT blueprint (a 2P horizontal tracker)

6. Solar Array Glare

Solar panels are designed to capture and hold light; and turn those photons into electrons.

PV solar panels are designed to reflect as little sunlight as possible (generally around 2% of the light received (US Department of Energy Solar PV and Glare Fact Sheet), resulting in negligible glare.

The reason for this is that PV panels are designed to absorb as much solar energy as possible in order to generate the maximum amount of electricity or heat.

The panels will not generally create noticeable glare compared with an existing roof or building surface (NSW Department of Planning 2010) and is similar to smooth water (US Dep of Energy 2018).

Aluminium and galvanised steel surfaces within the array area have also been considered for their reflectivity properties in preparing this report.

The project will use '2x Panel' single-axis tracking infrastructure (with the axis of rotation-oriented north-south). An example of 2P trackers can be viewed in figure 3.

The horizontal tracking motion of the solar panels throughout the day results in reflections being generally directed upwards and hence not visible by ground-based receivers.

In the uncommon event that a nearby elevated receiver can observe the array, any reflections would be seen as "low incidence" reflections with corresponding low reflectivity. This is the foreseeable outcome of the aim of maximising the solar generation of each panel and vindicating the additional cost of using a tracking system for the array which follows the sun, rather than a fixed panel system

7. Solar Panel Reflectivity

Solar PV panels are designed to absorb and capture the maximum possible amount of light within the layers below the anterior surface. Accordingly, solar PV panels are designed to minimise reflections off the surface of each panel. Reflections that do occur are a function of:

- the angle at which the light is incident onto the panel (which will vary depending on the specific location, time of day and day of the year), and
- the index of refraction of the front surface of the panel and associated degree of diffuse (non-directional) versus specular (directional or mirror-like) reflection which is a function of surface texture of the front module (reflecting) surface.

Some typical reflectivity values (given in terms of the "n" refractive index value) are:

• Snow (fresh, flaky)	n = 1.98	
• Standard Window Glass	n = 1.52	
• Plexiglass, Perspex	n = 1.50	
• Solar Glass	n = 1.33	
• Solar Glass with AR Coating	n = 1.25	] ← Standard PV Solar Panels

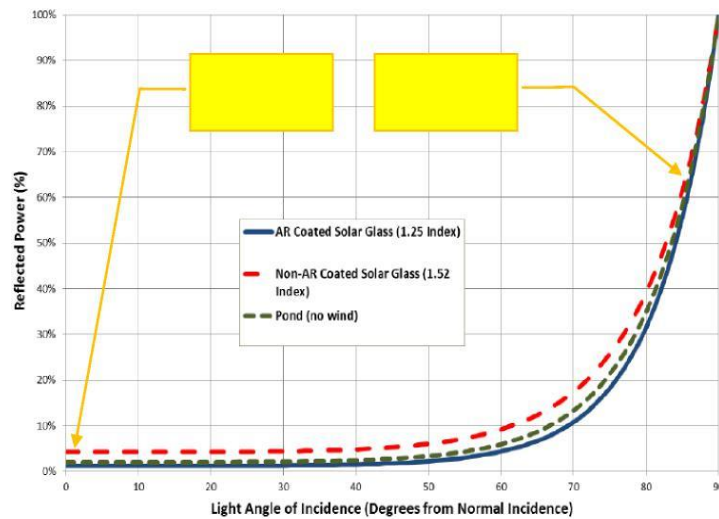
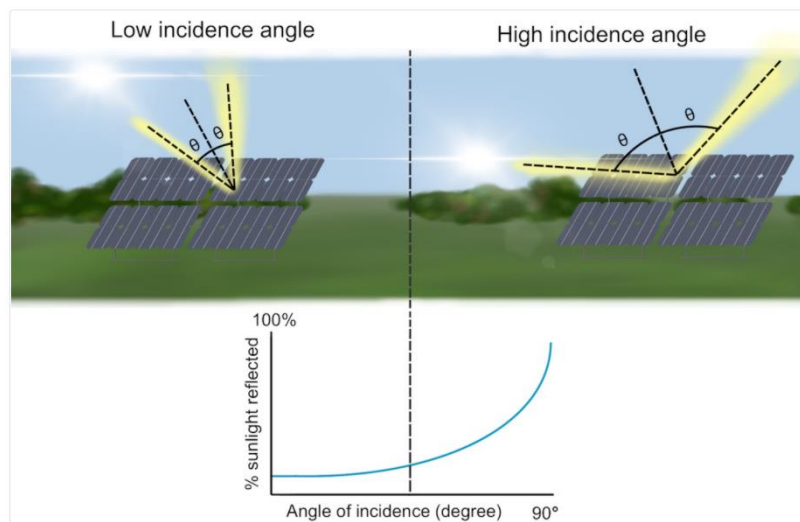


Figure 4: Typical Reflectivity curves as a function of incident angle, an adapted chart published on the “Physics Classroom” and adapted from Brewster, David (1815). “On the laws which regulate the polarisation of light by reflexion from transparent bodies”

Figure 4 shows

- When an oncoming solar ray strikes the surface of a solar PV panel close to perpendicular to the panel surface (*i.e.* low incident angle), the reflectivity percentage is minimal (less than 5% for all solar panel surface types)
- It is only when an incoming solar ray strikes the panel at a large incident angle, *i.e.* almost parallel to the panel, that reflectivity values increase. When this happens, reflections become noticeable and potentially at glare level for all solar panel surface types (as illustrated in figure 4i)
- Even for a very high incident angle reflection, it would almost always be the case that the observer (motorist, train driver, pedestrian, etc) would perceive reflections coming from virtually the same direction as the incoming solar rays themselves. Such a condition would not constitute a glare situation as the intensity of the incoming solar ray itself would dominate the field of vision perceived by the observer



PV panel reflectance depends on incidence angle between panel normal (*i.e.* facing) and sun position.
Large incidence angle yields more reflected sunlight.

Figure 4i: Forge Solar’s illustrative pv glare analysis image demonstrating incidence of angle reflection (tracking vs fixed)

8. Menz Solar Farm: Reflections Receivers

This report identifies a number of (potential and actual) receivers of the Menz Solar Farm.

Namely:

1. Commercial and private / local aviation
2. Motorists and pedestrians from the minor roads adjacent to the project
3. Line-of-sight residences
4. Heavy industrial and agricultural machine operators

Given that the nearby railway line (1.1km) is obstructed from a clear line of sight and not affected by any solar array reflections arising from the project, we have omitted a glare assessment for train drivers and line operators/maintenance staff.

Section 9 provides a glare and glint assessment for the receivers listed above, based on the infrastructure proposed and listed in section 5 (the project will use 2P single-axis tracking panels with the axis of rotation-oriented north-south as the panels track east to west daily).

The glare assessment discusses in detail in following sections is based on the following assumptions:

- The solar panel array trackers are “single-axis” capable of rotating solar panels to a maximum of $\pm 60^\circ$.
- The trackers are oriented north-south and spaced 10.0m apart;
- Individual panels (approximately 1.0m x 2.0m) reach a maximum height above ground of approximately 4.5m at their full $\pm 60^\circ$ tilt angle; and
- The western-most tracker is located beyond the vegetation screening and ridgeling, approximately 400m from the nearest minor thoroughfare being Black Gully Road.

As a result of the tracking movement of the solar panels throughout the day, reflections will generally be directed upwards and hence not visible by ground-based receivers. Where such reflections can be observed by surrounding elevated receivers they would be seen as “low incidence” reflections with corresponding low reflectivity. This is the inevitable outcome of the objective of maximising the solar gain of each panel (where the reflectivity would ideally be minimal) and justifying the additional cost of using a tracking system for the panels which follows the sun, rather than a fixed panel system.

9. Glare Impact Assessment: Discussion on receiver impact

9.1. Airports and control towers

Disruptive glare and glint impact on aviation operations pose significant risk. There have been several documented cases globally, none in Australia, of solar panel installations at airports interfering with Airport Control Tower operations. There is the added potential for reflective glare to impact pilots especially during the latter approach stages of landing, when the line of sight of the pilot is directed downwards. The disruptive reflections were shown to strike when the ‘angle of incidence’ of incoming solar rays was ‘high’ on fixed solar arrays.

When assessing the likely impact of the Menz solar farm on airport operation, it must be noted that the project is located a minimum of 14km from the nearest CASA registered commercial airport (see

figure 5). The substantial distance from a registered airport leaves this report to conclude that any impact on airport or control tower operations is nil.

9.2. Low altitude flights

Given the surrounding agricultural land usage in the vicinity of the project site, it is possible that aerial spraying might take place within kilometres of the project. There are no “standard” aircraft flight paths associated with such aviation activity.

Additionally, pilots flying aircraft at low altitudes such as helicopter trips may take a flight path which navigates across or near the Menz Solar Farm.

An analysis of the available evidence of whether the project would cause an unacceptable risk of disabling glare or glint to low altitude aircraft is deemed appropriate.

Publicly available development application submission documents registered with Tamworth Regional Council for similar 5MW solar farm developments reveal quantitative analyses was undertaken using the Solar Glare Hazard Analysis Tool (SGHAT), under the following assumptions:

- Assume potential flight paths whereby an aircraft is flying horizontally towards the Project sites from any direction and at an elevation of 60m above local ground level;
- Assume that the aircraft can get as close as 1 km to the nearest part of the Project’s solar array;
- Assume that solar panels track the sun during the day, tilted from 60 east to 60 west, about a horizontal axis oriented north-south.

When considered for a full year of potential incoming solar angles at latitudes, the potential for aviation glare was found to be negligible. This was primarily due to the low incidence angle of reflected rays (regardless of the time of the year) arising from the tilting action of the tracking systems.

The risk of disabling glare to low altitude aircraft was found to be very low or nil; with the 5MW solar farms having subsequently been assessed and ‘approved’ by Tamworth Regional Council planning department.

Projects in the Tamworth Regional Council Local Government Authority area have very similar latitude, topography and agricultural surrounds as the Menz Solar Farm. It is therefore a reliable inference to suggest that the quantitative SGHAT analyses for those projects provide foundational evidence supporting a conclusion that the Menz Solar Farm will not cause unacceptable aviation glare to low altitude aircraft.

Finally, it should be noted that here in the Northern region of NSW, the 68MW Moree Solar Farm (operating) and 700MW Uralla Solar Farm (approved through the State Significant planning process) are both located in areas of high agricultural activity; as well as both being proximately close to the regional airports of Moree and Armidale. These developments provide further precedence that the glare impact of utility solar farms on low attitude aircraft has been assessed as low to nil.

9.3. Commercial and private aviation

As figure 5 shows, the distances to the nearest commercially operated airports are significant.

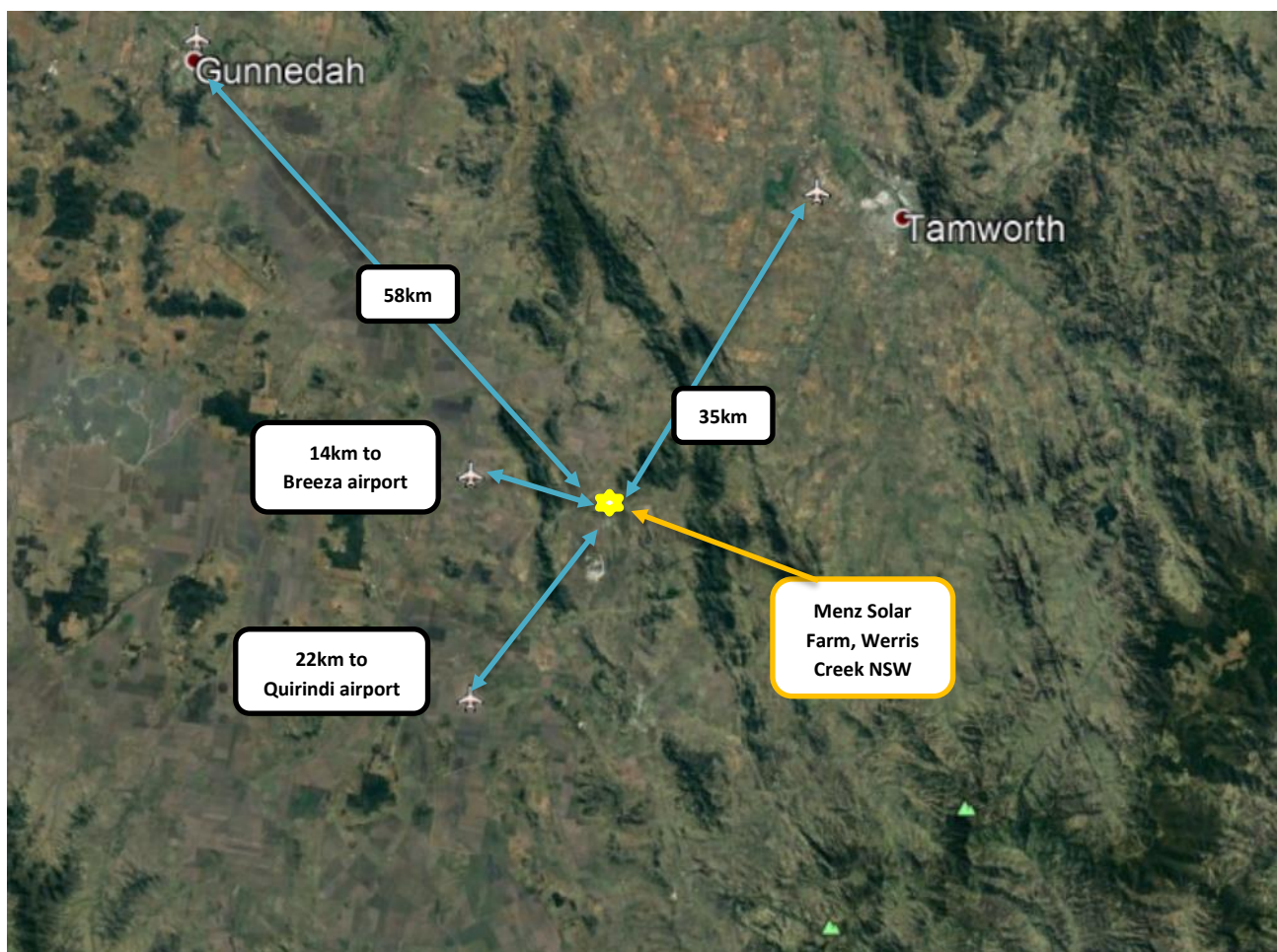


Figure 5: Proximity to regional airports.

Seen from above (such as from aircraft) solar panels appear dark grey and do not generally cause a glare or reflectivity hazard. Solar photovoltaic farms have been installed on a number of airports around the world, indicating their low adverse glare risk to aviation.

Guidance in this area is available from two sources – The United Kingdom Civil Aviation Authority (UK CAA) and the United States Federal Aviation Authority (US FAA). The FAA regulates and oversees all aspects of American civil aviation. Based on the above and other technical R&D references, the FAA issued a Technical Guidance Policy in 2010 and a subsequent (and over-riding) Interim Policy in 2013. The Technical Guidance Policy was updated in 2018.

Figures 6 and 7 below demonstrate the airspace structure of Tamworth Airport from 2019, being the largest airport in the region and the majority of low altitude flight paths. Werris Creek sits outside the main Tamworth airport airspace structure surrounding the Tamworth aerodrome. Low altitude flights H66 (Melbourne via Tamworth to Gold Coast) and W359 (one-way Mudgee) travel over or close to Werris Creek, however these are low altitude and prior to any landing approach; and considering that solar panels appear dark grey and do not generally cause a glare or reflectivity hazard.

It is therefore concluded there is nil risk of adverse reflections causing disabling glare from the project to in relation flights that may travel over the Menz solar farm.

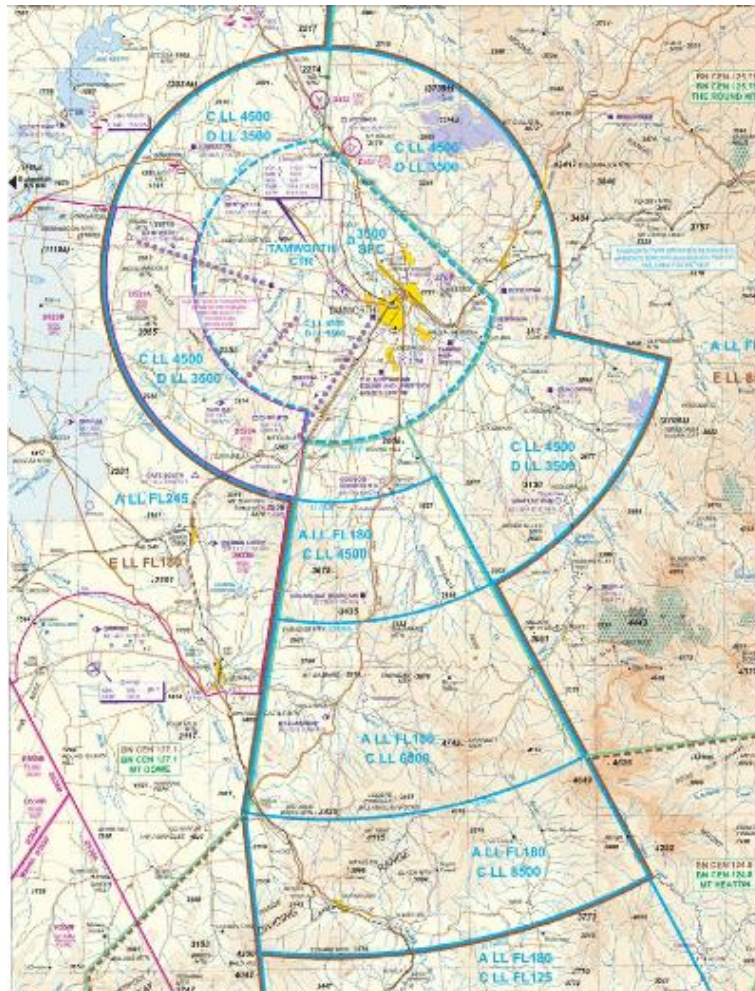


Figure 6: Tamworth Airport airspace structure.

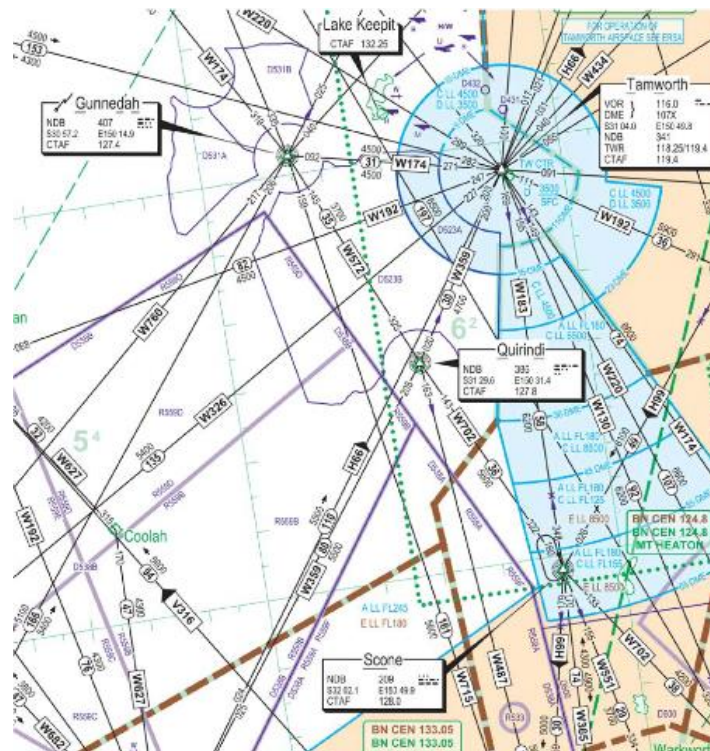


Figure 7: Tamworth Airport low altitude flight paths

9.4. Motorist disability and pedestrian discomfort reflective glare

The issue of concern here is the potential occurrence of Traffic Disability Glare, which most often arises from incoming solar rays striking a reflective surface at a moderately high (“glancing”) incident angle (typically greater than 70°) and altitude angle less than 25° (altitude angles greater than this would be intersected and obstructed by a typical windscreen roof-line).

The criteria commonly used by Local Government Authorities to assess the tolerability or otherwise of road traffic glare events utilise the so-called *Threshold Increment* (TI) Value of the reflection condition (TI is the measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Higher TI values correspond to greater disability glare AS 4282-1997).

These acceptability criteria were originally developed to address adverse reflections from the glass curtain wall façade systems of medium and high-rise buildings located close to road carriageways.

- For (Motorist) Traffic Disability Glare, the TI Value should remain:
 - Below 10 for major roads
 - Below 20 for minor roads
- For Pedestrian Discomfort Glare, the TI Value should remain:
 - Below 2 at critical locations such as pedestrian crossings
 - Below 3 for other locations

The TI Value is calculated as the ratio of “veiling” luminance to the overall average carriageway luminance, with the necessary constant and exponent parameters provided in AS 1158.2:2005. As figure 6 shows (below), a number of (sections of) minor roads will have views of the project; namely

- Black Gully Road, Anzac Parade, Punyarra and George Streets



Figure 8: Highlighted areas containing minor Roads and residences with line of sight through to Menz Solar Farm

The available evidence indicates that at all times throughout the year, even as seasonal variations see the angle of solar rays strike incident change; the single axis tracking motion of the solar farm arrays negates motorist disability from reflective glare off the project. Thus, the projects TI ratings are assessed as registering lower than the TI values which would indicated disabling (motorists) or discomforting (pedestrians) reflective glare being caused by the project.

This conclusion also draws on the evidenced based discussion in section 6 *“The horizontal tracking motion of the solar panels throughout the day results in reflections being generally directed upwards and hence not visible by ground-based receivers”*

It is also noted that there are no critical pedestrian junctures affected by a line-of-sight through to the solar farm, and there are no adverse glare impacts anticipated to cause pedestrian discomfort from the project.

Finally, the project’s location within the area’s topography offers favourable, natural screening. The ridgeline on the western border of the project and planned vegetation screens will diffuse line-of-sight views through to the solar farm for motorists and pedestrians on the affected minor roads.

9.5. Residential Nuisance Glare

The documented instances of nuisance glare associated with solar PV panels (grid-scale, industrial or residential) and nearby residential receivers have been relatively scarce and few globally, given the widespread and rapid increase in the take-up of residential solar panels in Australia and elsewhere.

Figure 8 identifies the majority of the residential receivers affected by line-of-sight through to the Menz Solar Farm. These residences are primarily located in the town of Werris Creek.

There are currently no national or state guidelines in Australia governing the acceptability or otherwise of nuisance glare specific to solar PV, although the concepts used for glare acceptability criteria in the preceding sections can assist when dealing with this issue.

Existing guidance in relation to solar panels from state governments typically covers installation audits and compliance checks. Additional guidance in relation to compliance with Australia Standards is provided by the Clean Energy Council - website: www.cleanenergycouncil.org.au

It is therefore prudent to draw upon section 6 again in reiterating the evidence that *“The horizontal tracking motion of the solar panels throughout the day results in reflections being generally directed upwards and hence not visible by ground-based receivers”*; and that *“In the uncommon event that a nearby elevated receiver can observe the array, any reflections would be seen as “low incidence” reflections with corresponding low reflectivity. This is the foreseeable outcome of the aim of maximising the solar generation of each panel and vindicating the additional cost of using a tracking system for the array which follows the sun, rather than a fixed panel system.”*

Thus, this report concludes that the risk of nuisance reflective glare impacting nearby residential receivers is negligible to nil.

9.6. Industrial machinery operations

The issue here primarily relates to users of agricultural equipment operating within 'line-of-sight' to the Menz Solar Farm, and an unacceptable risk of reflective glare striking a machinery operator (receiver).

There are no industrial scale operations within a line-of-site of the proposed solar farm, with users of agricultural machinery within line-of-sight proximity of the solar farm being infrequent and varied in their times of operation.

There are currently no (Australian) national or state guidelines governing the acceptability or otherwise of reflective glare for industrial site critical operations. Instead, the concepts used for acceptability criteria in the preceding sections, in particular Motorist Disability Glare, can assist when dealing with this issue.

As has been highlighted in other aforementioned sections, the physical and operational characteristics of solar panels combined with the single axis tracking system used in the solar farm significantly reduces the likelihood of any disabling reflective glare effects on agricultural or industrial machinery operators.

This report concludes that the risk of unacceptable reflective glare on industrial or agricultural machinery operators from the project is very low to nil.

10. References

AS 4282-1997 *Control of the Obtrusive Effect of Outdoor Lighting*

Clean Energy Council website: www.cleanenergycouncil.org.au

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Tamworth Regional Council DA 2020/0397 Manilla 5MW Solar Farm proposed by NSW Community Renewables

Tamworth Regional Council DA 2021/0295 Country Road, Warral 5MW Solar Farm proposed by NSW Community Renewables

Tamworth Regional Council DA 2021/0317 Kootingal 5MW Solar Farm proposed by ITP Renewables

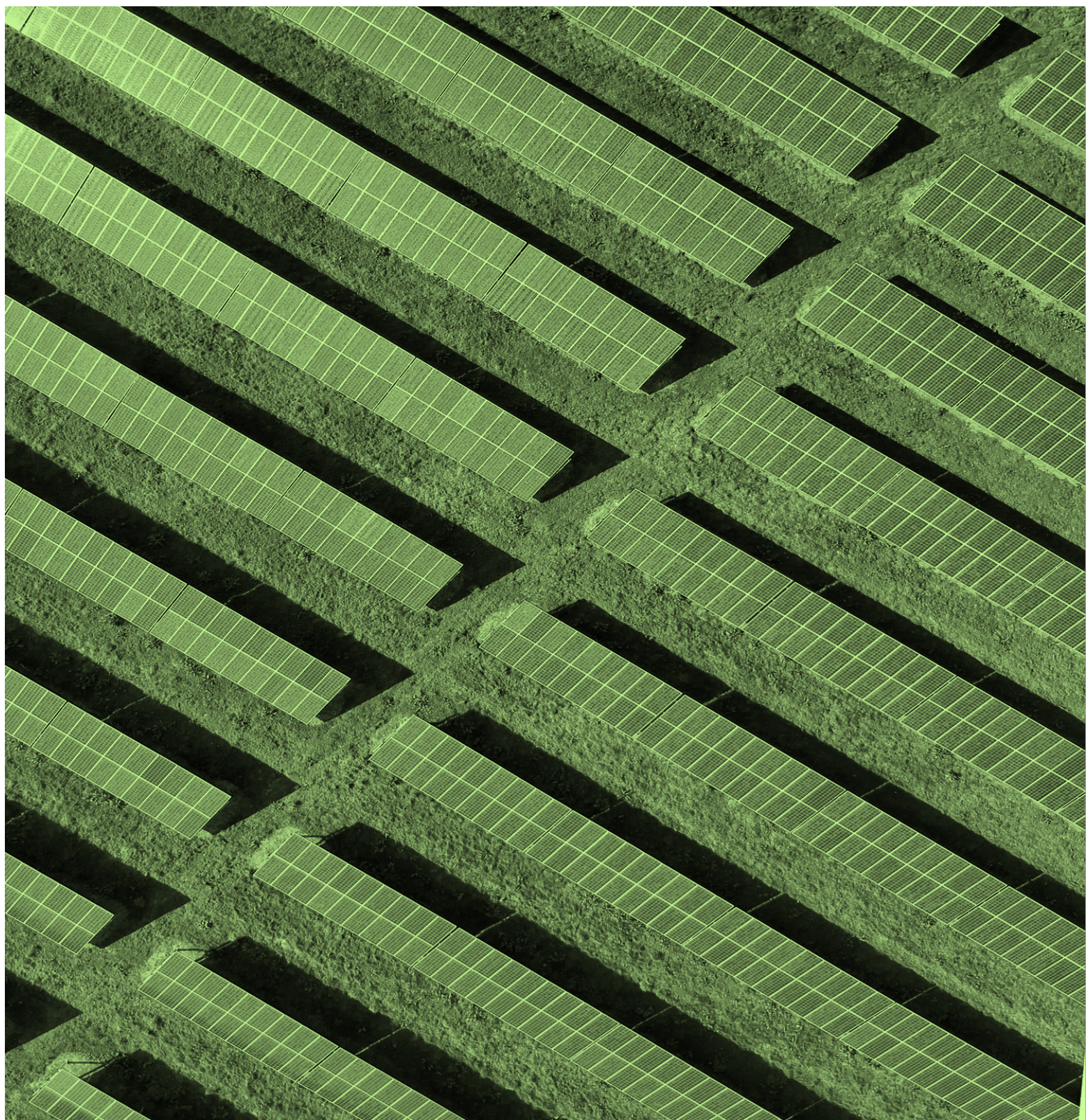


Menz Solar Farm | Development Application

SOCIAL IMPACT STATEMENT

Prepared for KDC Pty Ltd | 30 September 2020





Menz Solar Farm

DEVELOPMENT APPLICATION | SOCIAL IMPACT STATEMENT

Prepared for KDC Pty Ltd
30 September 2020

PR140

Prepared by		Reviewed by
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Signature		
Date	30 September 2020	30 September 2020

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DOCUMENT CONTROL

Revision	Date	Description	Prepared by	Reviewed by
0	23 September 2020	Preliminary draft for KDC Pty Ltd review	Element Environment	KDC Pty Ltd
1	30 September 2020	Final version for submission	Element Environment	KDC Pty Ltd

Certification page

Lead author declaration

I, Dr Jamie Seaton, certify that the social impact statement (SIS) component of the Menz Solar Farm Development Application contains information relevant to the SIS for the project, and that the information is not false or misleading. My qualifications and experience are listed below.

Qualifications:

1. Bachelor of Science Hons. (Human Geography)
2. Community Development Diploma
3. Doctorate of Philosophy (Human Geography).

Experience:

I am trained in social science methods and I have demonstrated social impact assessment skills in government and private settings across a variety of sectors. I have managed and authored social impact studies in New South Wales and Queensland.

Date: 30 September 2020



Jamie Seaton - SIA and Community Engagement Lead

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1 INTRODUCTION

1.1 Background

KDC Pty Ltd (KDC) is preparing a development application (DA) for the construction and operation of the Menz Solar Farm at Werris Creek, NSW (the project). The project would be at Lot 1 DP 509915 on Black Gully Road in the Liverpool Plains Shire Council, less than 1 kilometre (km) east of Werris Creek (see Figure 1). This social impact statement (SIS) has been prepared by Element Environment Pty Ltd (Element) to support the DA.

The project is surrounded by mixed regional land uses, including primary production (grazing, cropping), residential (Werris Creek) and mining (Werris Creek coal mine). There are several small retail and accommodation businesses operating in Werris Creek, which is less than 1 km from the project, as well as public services such as a community hospital, swimming pool and public school. The Werris Creek open-cut coal mine, owned and operated by Whitehaven Coal, is the most significant business in the suburb.

1.2 Social impact statement objectives

The objective of this SIS is to develop a community profile, social baseline, and stakeholder analysis to be used for:

1. identifying and assessing potential positive and negative social impacts of the proposal;
2. developing measures to enhance potential positive impacts and mitigate potential negative impacts; and
3. providing recommendations to accompany the DA.

The assessment of social impacts will:

- be limited to desktop research and will integrate findings from other specialist studies completed for the project; and
- adopt the framework of the *Social Impact Assessment Guideline* (the guideline) (DPIE, 2017) which is recognised as the best practice guideline in NSW. The assessment will address the applicable social impact categories identified in the guideline (see section 3).

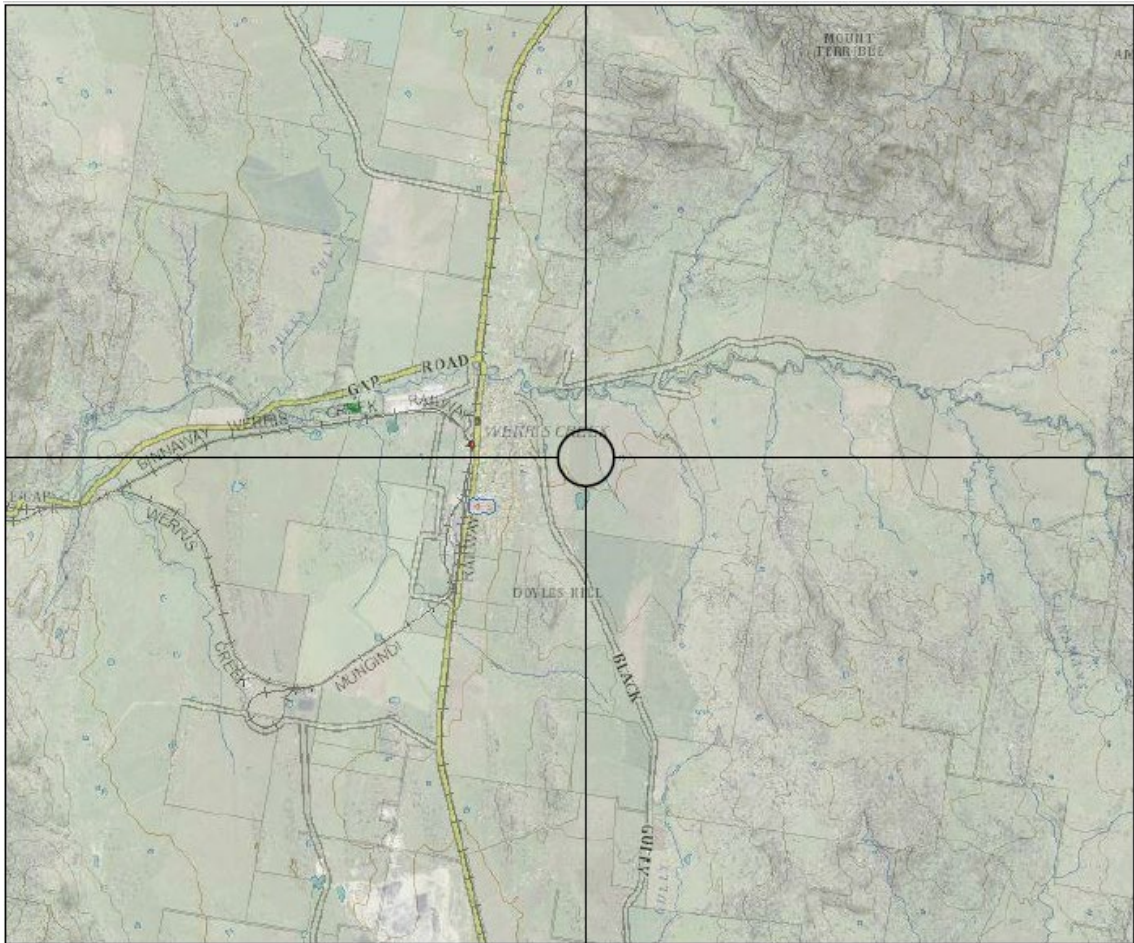


Figure 1 – Project location

Source: Daniel Lawless Drafting Services, 2020

1.3 The proposal

Wynergy Pty Ltd (Wynergy) is submitting a DA to construct and operate a solar farm east of Werris Creek. The proposed agrivoltaic solar farm project is one of Wynergy's solar initiatives to be rolled out across regional Australia, with multiple benefits for rural and regional communities.

The proposal includes a no larger than 5 mega-watt (MW) grid-connected solar photovoltaic (PV) installation. Once established, the solar farm will be connected to the adjacent powerline originating from the Essential Energy Werris Creek Zone Substation. The proposed development aims to erect approximately 12,960 solar PV panels producing 405 watts. Other electrical generation infrastructure is proposed on the site including inverters, and a transformer. Due to the capacity of the inverter system, the proposed development will produce less than 5 MW. Most of the infrastructure would be pre-fabricated off-site, delivered and assembled on-site.

The PV arrangement will consist of 216 ground mounted single axis trackers. The PV arrays will have a clearance above the existing ground surface and extend to approximately 2 m at maximum tilt. The PV mounting structure would comprise steel posts driven to approximately 1.5 m below ground using a small pile driver. Additional support structures will be attached to the piles, which would then support the PV panels.

A 3 m and 5 m wide access road is proposed connecting the solar farm to the approved access to Black Gully Road at the southwest area of the lot. Gate access is provided in the southwest corner. A car park area, off load area and construction laydown area are indicatively located on the General Arrangement Plan.

The solar PV farm will operate 24 hours a day, 7 days a week, with no permanent staff on site. Maintenance inspections will be undertaken on an as needs basis.

1.4 Strategic community context

NSW Government state and regional strategies provide a context for the project. The most pertinent strategy at the regional scale is the *New England and North West Regional Plan (draft)* (NSW Department of Planning, Industry and Environment, 2016). A goal of the plan is to create a diversified economy in the region through the management of energy resources, including renewable energy generation. The plan recognises the region that hosts the project has potential to be a solar power generation leader. "The region receives 19 to 20 megajoules daily of solar exposure, making it the second highest solar penetration region in NSW...and [it has proposed] solar farms that will generate job opportunities and investment in the economy from construction, operations and connection to the State's electricity grid" (NSW Department of Planning, Industry and Environment, 2016, p.34). The project is ideally placed to assist the region in reaching this potential.

The NSW Electricity Strategy (NSW and Department of Planning, Industry and Environment, 2019) also sets a strategic objective supported by the project. The strategy is the NSW Government's plan for a reliable, affordable and sustainable electricity future. It involves:

- supporting the market to deliver reliable electricity at the lowest price;
- setting an energy security target to ensure that the state has sufficient generation capacity to cope with unexpected generator outages; and
- ensuring the state has sufficient powers to deal with an electricity emergency.

"Construction of new generation to replace existing power stations" (NSW and Department of Planning, Industry and Environment, 2019, p1) is an important feature of the strategy and the project would respond directly to this need.

At a local scale, the *Liverpool Plains Community Strategic Plan 2017-2027* (Liverpool Plains Shire Council, 2017) is the primary community strategy relevant to the project. The local council undertook a survey in 2017 in the LGA to better understand what the long-term aspirations were for communities in the shire over the next ten years. A key 'want' from the community is the exploration and adoption of renewable energy sources for future energy requirements. The local council identified a key performance measure to be a reduction in greenhouse gas emissions and an increase in renewable energy use. The proposal therefore strongly aligns with the key 'wants' identified by the Liverpool Plains Shire community.

2 THE EXISTING SOCIAL ENVIRONMENT

The project is in a social environment defined by the Werris Creek community profile and its stakeholders. The community profile and an analysis of project stakeholders are outlined below, in addition to the social baseline for the project.

2.1 Community profile

A community profile illustrates the characteristics of a population residing in a defined geographic area. Data from the *Australian Census of Population and Housing* (Australian Bureau of Statistics, 2018) is the most accurate available and, subsequently, it has been adopted for the community profile below.

Werris Creek (suburb) has been selected as the area relevant to the project and Table 1 identifies the characteristics of its resident population. Comparative data is provided for the NSW population.

Table 1 – Werris Creek community profile

Characteristic	Measurement	
	Werris Creek	NSW
People	1,572	7,480,228
Male	51.50%	49.30%
Female	48.50%	50.70%
Median age	49	38
Families	386	1,940,226
Average children per family (families with children)	1.8	1.9
All private dwellings	782	3,059,599
Average people per household	2.1	2.6
Median weekly household income	\$786	\$1,486
Median monthly mortgage repayments	\$919	\$1,986
Median weekly rent	\$190	\$380
Average motor vehicles per dwelling	1.6	1.7

Source: Australian Bureau of Statistics, 2018

There is a marginally larger group of males than females in the Werris Creek population. This scenario is the inverse of the NSW population, where the females contribute a marginally larger population than males. The median age of the Werris Creek population (48 years) is noticeably higher than the NSW population (38 years).

The Werris Creek population is almost identical to the NSW population in terms of the composition of families with children, with the average number of children per family being 1.8, compared to 1.9 children per family in NSW at the 2016 census.

Measurements associated with private dwellings are the last group included in the community profile. On the 2016 census night Werris Creek had a lower average number of people per household (2.1) compared to NSW (2.6).

In terms of accommodation costs, measurements for the Werris Creek population is lower in every category when compared to the broader NSW population.

The general financial situation of the Werris Creek population appears to be comparatively advantageous when accommodation costs are considered alongside the median household

incomes for the respective populations. This is because by household, the Werris Creek population earns a higher weekly household income compared to what each household commits to mortgage repayments or weekly rent. It is however worth noting that the reported median income and accommodation costs for the Werris Creek population are almost half of the median income and accommodation costs reported for the NSW population.

Finally, the Werris Creek population was recorded on the 2016 census night to have 1.6 average motor vehicles per dwelling, marginally lower compared to the NSW population that had 1.7. This pattern is typical of regional communities that are more reliant on private vehicles than public transport, which is more accessible in major cities.

2.2 Stakeholder analysis

Project stakeholders contribute to the existing social environment and have been identified via desktop research. Table 2 lists the stakeholders and predicts their interest in the project.

Table 2 – Stakeholder analysis

Stakeholder	Description	Interest
Werris Creek Community Hospital	Provides community health services weekdays.	Noise and visual amenity impacts.
Werris Creek Swimming Pool	Active recreation area.	Noise and visual amenity impacts.
The Old Signal Hotel and Guesthouse	Commercial premises providing hospitality services.	Business opportunities.
Railway Hotel	Commercial premises providing hospitality services.	Business opportunities.
Russel Street, Black Gully Road and Punyarra Street	Nearest residential receivers.	Noise, visual, air quality, traffic impacts (including car parking and pedestrian risk).
Liverpool Plains Shire	Local authority.	General amenity of residential neighbourhood. Social and economic impacts. Change in land use.

3 ASSESSMENT OF SOCIAL IMPACTS

The *Social Impact Assessment Guideline* (DPIE, 2017) defines a social impact as a consequence experienced by people due to changes associated with a proposal. The Guideline further clarifies that social impacts involve changes to people's:

- **way of life**, including:
 - how people live, for example, how they get around, access to adequate housing
 - how people work, for example, access to adequate employment, working conditions and/or practices
 - how people play, for example, access to recreation activities
 - how people interact with one another daily
- **community**, including its composition, cohesion, character, how it functions and sense of place;
- **access to and use of infrastructure, services and facilities**, whether provided by local, state, or federal governments, or by for-profit or not-for-profit organisations or volunteer groups;
- **culture**, including shared beliefs, customs, values and stories, and connections to land, places, and buildings (including Aboriginal culture and connection to country);
- **health and wellbeing**, including physical and mental health;
- **surroundings**, including access to and use of ecosystem services, public safety and security, access to and use of the natural and built environment, and its aesthetic value and/or amenity;
- **personal and property rights**, including whether their economic livelihoods are affected, and whether they experience personal disadvantage or have their civil liberties affected;
- **decision-making systems**, particularly the extent to which they can have a say in decisions that affect their lives, and have access to complaint, remedy and grievance mechanisms; and
- **fears and aspirations** related to one or a combination of the above, or about the future of their community.

For the purposes of this SIS, potential social impacts of the proposal (pre-mitigation) have been classified into three categories below. Neutral impacts are not discussed in this SIS.

1. Neutral –the proposal is perceived to have a neutral impact on these aspects.
2. Positive –the proposal is perceived to have a positive impact on these aspects.
3. Negative – the proposal is perceived to have a negative impact on these.

3.1 Neutral impacts

The proposal is not anticipated to involve changes to people's:

- access to and use of infrastructure, services and facilities;
- culture;
- personal and property rights;
- decision-making systems; and
- fears and aspirations.

3.2 Positive impacts

Way of life

Positive impacts to the way of life in Werris Creek would be created most strongly during project construction. In particular, the project if approved is predicted to influence how people work, including employment opportunities and business revenue.

An anticipated construction workforce of up to 30 people with construction to take place over 3-6 months' would produce a short-term demand for goods and services in the local area. The project would require a range of transport, earthworks, electrical, survey, and general construction contractors. There is potential for local tradespeople to secure work on the project and this would provide income that would not otherwise be available.

The labour force employed by the project would likely purchase supplies (e.g. fuel) and incidentals (e.g. groceries and meals) in Werris Creek. The expenditure would provide short-term buoyancy to local business revenue and potentially increase employment security for local employees.

Health and wellbeing

In the long-term the proposal is predicted to generate clean, safe and renewable energy. Increased carbon emissions contribute to air pollution and clean air is fundamental to the health and wellbeing of a community (DPIE, 2020). By not using fossil fuels to generate the energy, the proposal will contribute to a reduction in carbon emissions, mitigating potential air pollution and contributing to the improvement in the health and wellbeing of the community.

Potential short-term impacts from construction, such as dust and noise, has the potential to negatively impact the health and wellbeing of the community. These impacts however are short-term, intermittent and can be mitigated to avoid any significant impact. In relation to construction noise impacts specifically, an acoustic assessment (Muller Acoustic Consulting, 2020) of the project concluded that noise levels have potential to exceed relevant thresholds at several of the receivers nearest to the project, however, mitigation measures are available to reduce impacts to a compliant level.

The longer-term impacts presented by renewable energy are deemed to outweigh the short-term impacts of construction.

3.3 Negative impacts

Way of life and community

Small regional communities such as Werris Creek have strong community bonds and a way of life which closely aligned with their surroundings and sense of place. Small changes in these aspects of a community are often readily noticed and the impact magnified due to the small size of the town.

According to DPIE (2017), social impacts can arise from changes to a community's composition, character, and sense of place. In the context of the project, a change in land use from primary production to a solar energy system would create an obvious change to these aspects of the community in Werris Creek, particularly in the residential areas which overlook the project.

The proposal has the potential to impact the way of life and community of Werris Creek during construction due to the comparatively large labour force required to construct solar farms and the likelihood of this labour force interacting with the local community. However, the duration of

construction will be short and the long-term impacts to the community composition are considered negligible.

Surroundings

The surroundings of an individual will have a bearing on their social life. DPIE (2017) emphasises the relevance of public safety and security to this concept. In addition, it refers to aesthetic value and amenity as being important aspects of a person's surroundings.

The proposal would potentially create a moderate change to the visual amenity of the surrounding area, particularly for those properties which overlook the proposal site. Without mitigation, material visual amenity impacts would likely arise from the proposal. According to Moss Environmental (2020), these impacts would occur at:

- Rural / residential properties located on highly elevated locations off Black Gully Road (high impact); and
- Anzac Parade/Road and the electrical substation (moderate impact).

4 CONCLUSION AND RECOMMENDATIONS

This SIS has involved a desktop assessment of potential social impacts of the proposal. The SIS has adapted the social impact assessment framework of DPIE (2017) which is recognised as best practice for the discipline.

The assessment concludes that the proposal would positively impact the way of life in Werris Creek during construction, and the health and wellbeing of community in the long-term. The unmitigated negative impacts of the proposal include temporary changes to the way of life and community composition during construction, and a permanent change to the surroundings.

There are, however, mitigation measures that can be applied to each negative social impact to minimise their impact. If applied, the negative social impacts of the proposal are predicted to be low and immaterial.

Table 3 summarises the negative social impacts predicted for the proposal. For each impact, its description, social risk rating (i.e. high, moderate, low) and recommended mitigation measure is provided.

Table 3 - Summary of negative impacts and recommended mitigation measures

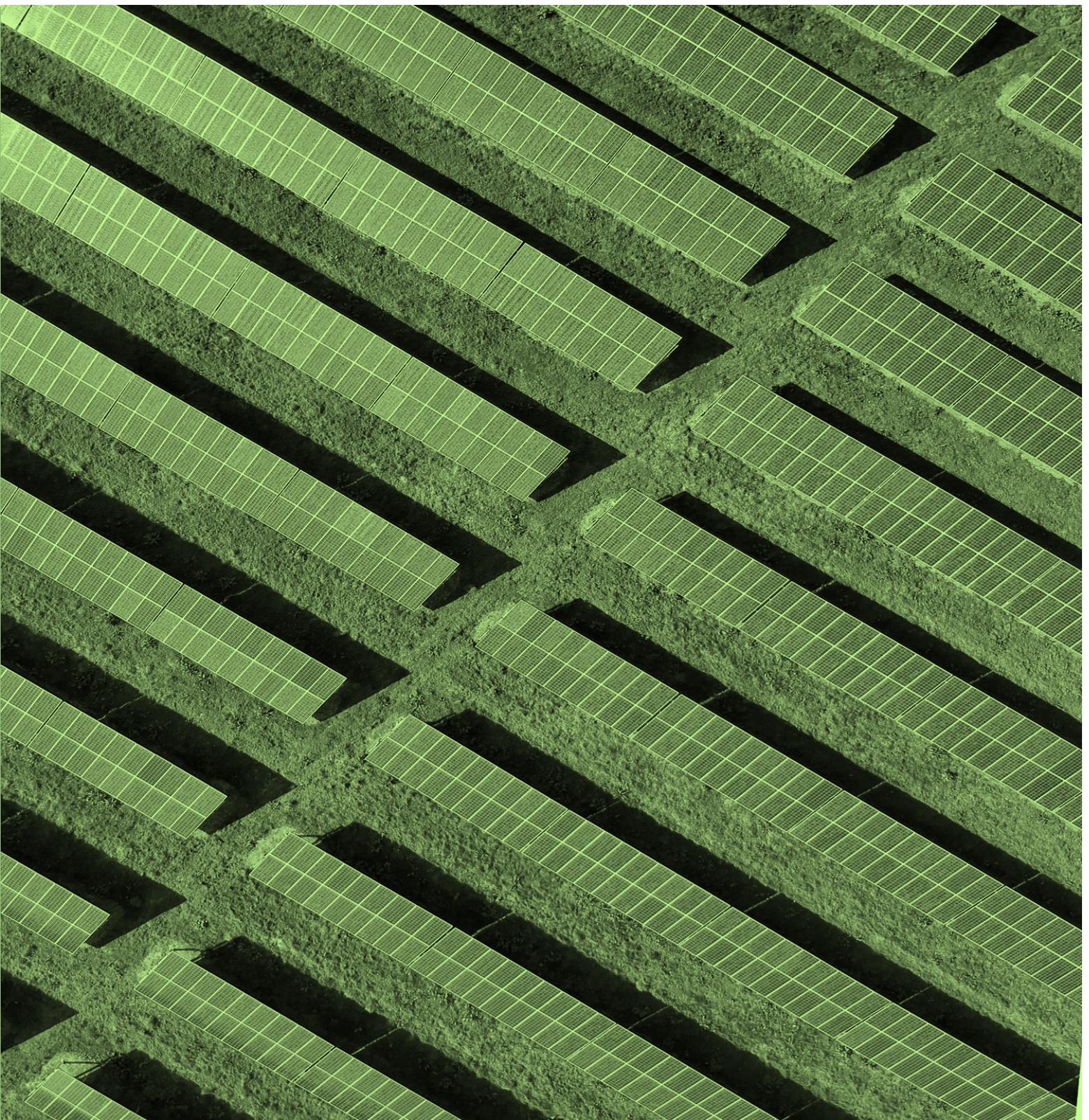
Social impact category	Impact without mitigation		Impact with mitigation	
	Impact description	Social risk rating	Recommended mitigation	Social risk rating
Way of life	How people live, work, play and interact daily.	Moderate	Proactive community consultation and notification in advance of any service or utility interruptions, traffic changes.	Low
Community	Community composition, cohesion, character, how it functions and sense of place.	Moderate (during construction only)	- Implement a Code of Conduct encouraging positive behaviour and expectations when interacting with the community. - Implement disciplinary processes for breaches in the Code of Conduct or other anti-social behaviour.	Low
Surroundings	Access to and use of ecosystem services, public safety and security, access to and use of the natural and built environment, and its aesthetic value and/or amenity	High	- Existing vegetation should be retained where feasible. - Vegetatively screen the development from receivers who are visually impacted. - Planting of vegetative screens should be commenced at the start of construction and should include native plant species sympathetic to plant communities found in the area. - Construction compounds and works areas should always be kept free of waste and debris. - All lighting should be designed and installed to avoid light spill.	Low

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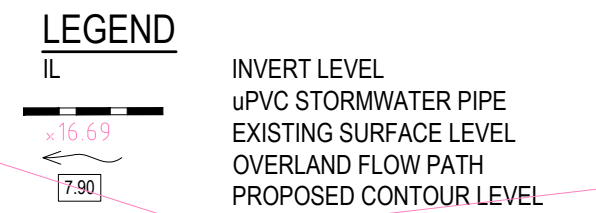


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[illegible]

25/09/2020

Project Number: 200419

STORMWATER MANAGEMENT REPORT

at

**WERRIS CREEK SOLAR FARM | 962 BLACK GULLY ROAD WERRIS
CREEK NSW**

for

WYNERGY c/- KDC Pty Ltd

Project No. 200419

Revision: B – Reissued for Da

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1. Introduction

DRB Consulting Engineers (DRB) were engaged by KDC Pty Ltd, on behalf of Wynergy to undertake a Stormwater Management Plan for the proposed Werris Creek Solar Farm, located at LOT 1 DP 509915 Black Gully Road, Werris Creek, NSW.

This report will provide commentary on the impact the proposed development will have on the existing site with regard to stormwater quantity.

It should be noted that, this report has been prepared to a level suitable for Development Application only.

This report should be read in conjunction with the Concept Stormwater Management plans 200419/CIV01-02.

2. Site Description & Proposed Development

The site is located at 962 Black Gully Road, Werris Creek. The site is located on the eastern side of Black Gully Road and is identified as Lot 1 DP 509915.

The proposed Werris Creek Solar Farm will be located in the Central-West portion of the site, known as the Investigation Area (IA).

At the time of this investigation, the IA was a vacant rural parcel of land approximately 22.03 Ha in area. The IA had a good grass coverage and sloped from the southwest to the northeast at slopes of approximately 2.5 – 3.5%.

The IA had an existing watercourse located in the eastern section of the site. During rainfall events, surface runoff from the IA would sheet flow across the site to the north before a series of earth bunds convey runoff to the east, discharging over the eastern boundary to this existing watercourse.

Figure 1 below shows the existing site and investigation area.



Figure 1 – Existing Site Boundaries

The proposed Solar Farm layout can be seen in Figure 2 below.

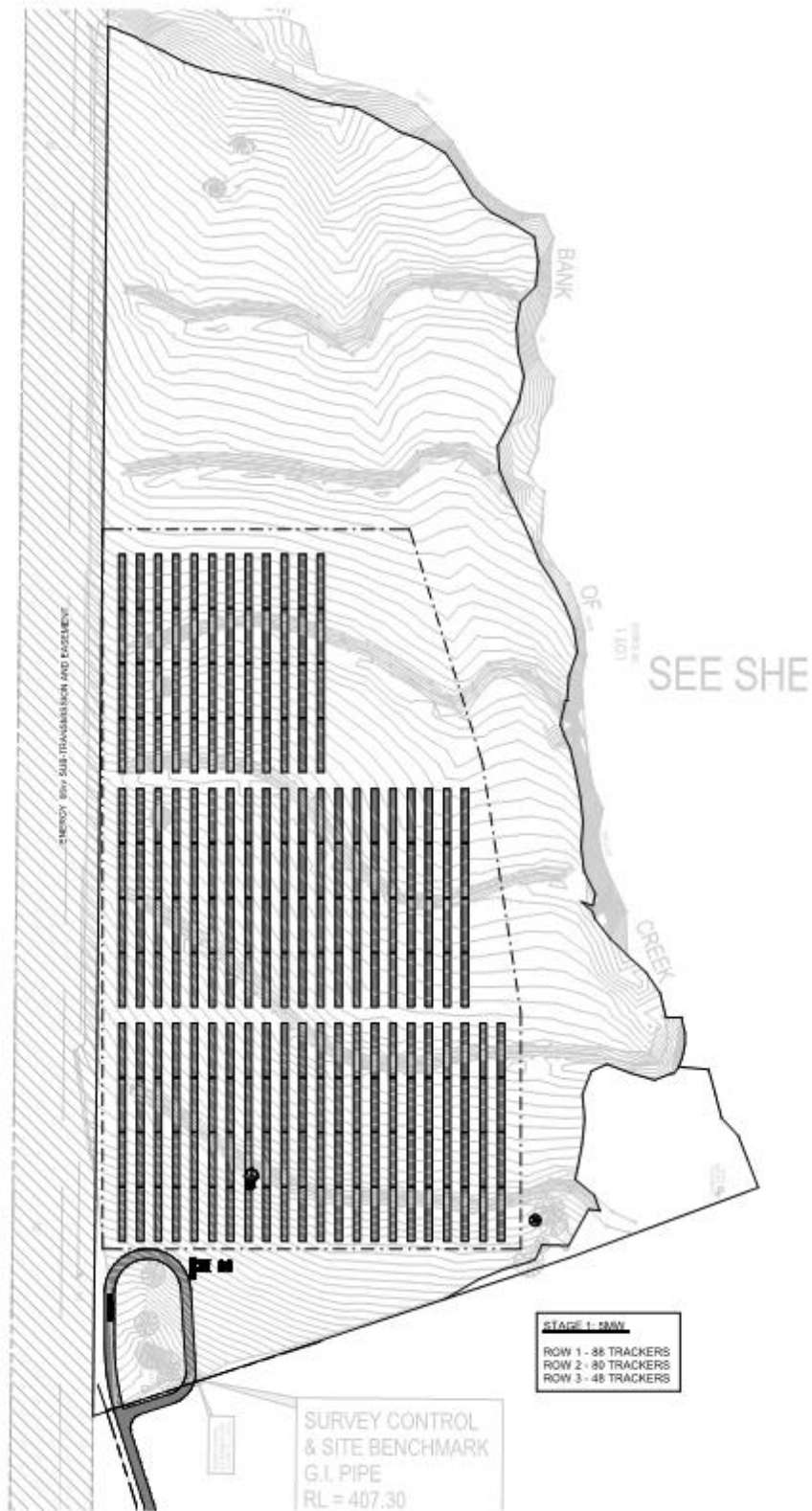


Figure 2 – Proposed Solar Farm

3. Council Requirements

A review of Liverpool Plains Shire Council's Development Plan and Engineering Guidelines identified that the site is subject to the requirement for Onsite Stormwater Detention.

- *The proposed development must detain stormwater runoff to ensure Post-Development flow rates are reduced to Pre-Development flow rates for all storm events up to and including the 1 in 100 year storm event.*

Furthermore, the site must discharge legally without causing nuisance flows onto neighbouring properties.

4. Water Quantity Analysis (Onsite Stormwater Detention)

4.1. Overview

The proposed development area has been split into three separate catchments for the assessment of Stormwater Quantity; the Photovoltaic Array stage and the Gravel / Hardstand catchments. Figure 3 below shows the proposed catchment boundaries.

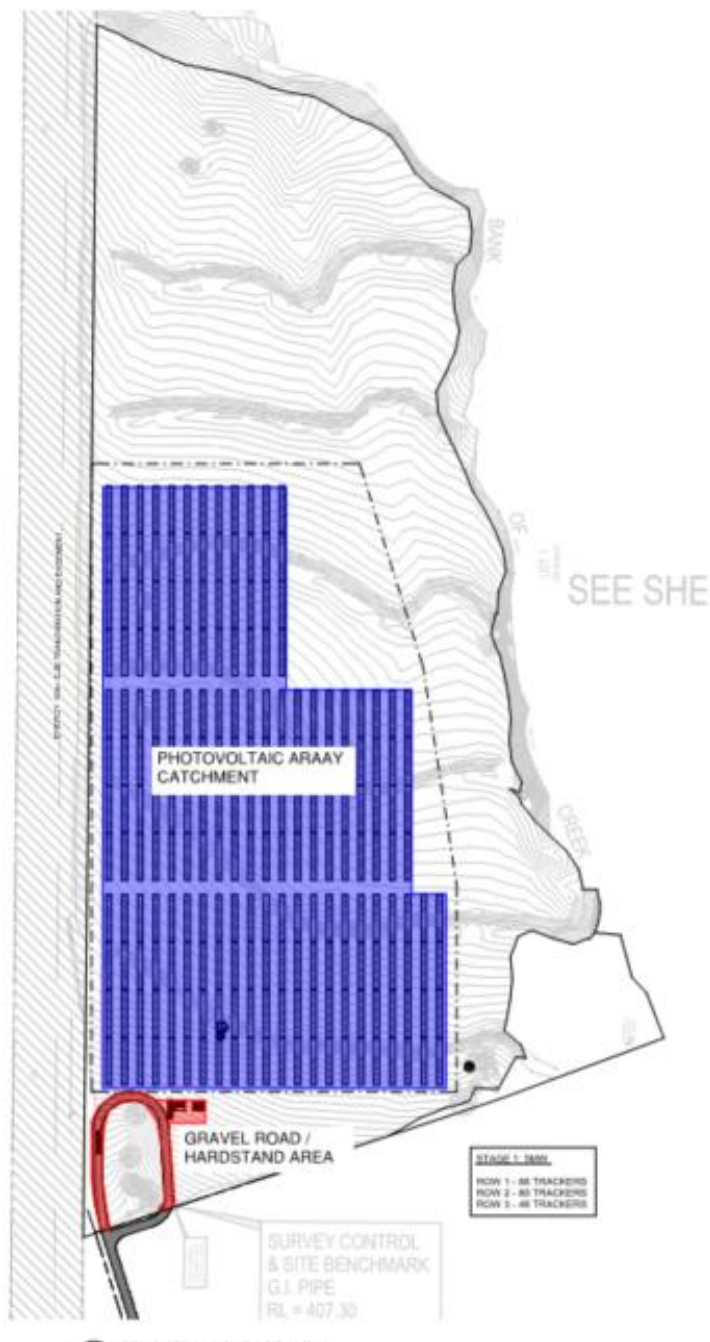


Figure 3 – Proposed Catchment Boundaries

4.2. Photovoltaic Array

The Photovoltaic Array will consist of 216 x Ground Mounted Single Axis Trackers. The array structure will be steel pile supported and will have approximately 500mm clearance above the existing ground surface.

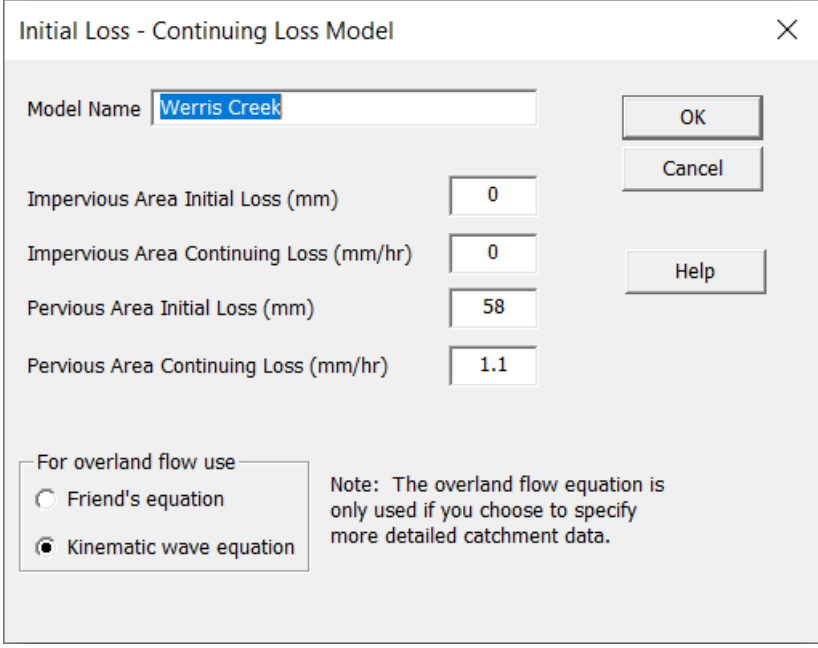
4.2.1. Pre-Development Peak Flows

The catchment characteristics for the Pre-Development catchment area can be seen in Table 1 below:

Construction Stage	Parameter	
Pre-Development	Sub-Catchment Area	79,490.0 m ²
	Percentage Impervious	0 %
	Flowpath Length	69.25 m
	Flowpath Slope	2.89 %
	Retardance Coefficient 'n'	0.075

Table 1 – Existing Catchment Parameters

A DRAINS model was developed to determine the pre-development peak flow rates. The DRAINS model used the *ARR 2019 Initial loss - Continuing loss (IL-CL) hydrological model* and 2016 IFD data. The Hydrological model parameters were determined using the ARR data hub and can be seen in Figure 4 below.



Initial Loss - Continuing Loss Model

Model Name: Werris Creek

Impervious Area Initial Loss (mm): 0

Impervious Area Continuing Loss (mm/hr): 0

Pervious Area Initial Loss (mm): 58

Pervious Area Continuing Loss (mm/hr): 1.1

For overland flow use:

☐ Friend's equation

☒ Kinematic wave equation

Note: The overland flow equation is only used if you choose to specify more detailed catchment data.

Buttons: OK, Cancel, Help

Figure 4 – Hydrological Model Parameters

The model was developed for the 1 EY (Exceedances per year), 10% AEP (Annual Exceedance Probability) and 1% AEP events and analysed the following storm durations.

5 minutes	30 minutes	12 hours
10 minutes	45 minutes	18 hours
15 minutes	1 hour	24 hours
20 minutes	2 hours	
25 minutes	6 hours	

The Results of the DRAINS model can be seen below in Table 2.

Construction Stage	Storm Event (Exceedance Probability / Annual Exceedance Probability)	Peak Flow
Pre-Developed	1EY	0.105 m ³ /s
	10% AEP	1.140 m ³ /s
	1% AEP	2.700 m ³ /s

Table 2 – Pre-Development Peak Flow

4.2.2. Post-Development Peak Flows

The Post-Development site conditions can be summarised below:

- (i) The proposed arrays will be at varying angles, however, in a worst-case runoff scenario, it is assumed the arrays are horizontal to the existing ground surface level.
- (ii) Runoff from the proposed arrays will fall immediately on to the untouched natural ground surface.
- (iii) The pervious area under the arrays will not receive direct rainfall, however, it will be available for both initial and continuing loss for the runoff of the array immediately upslope.

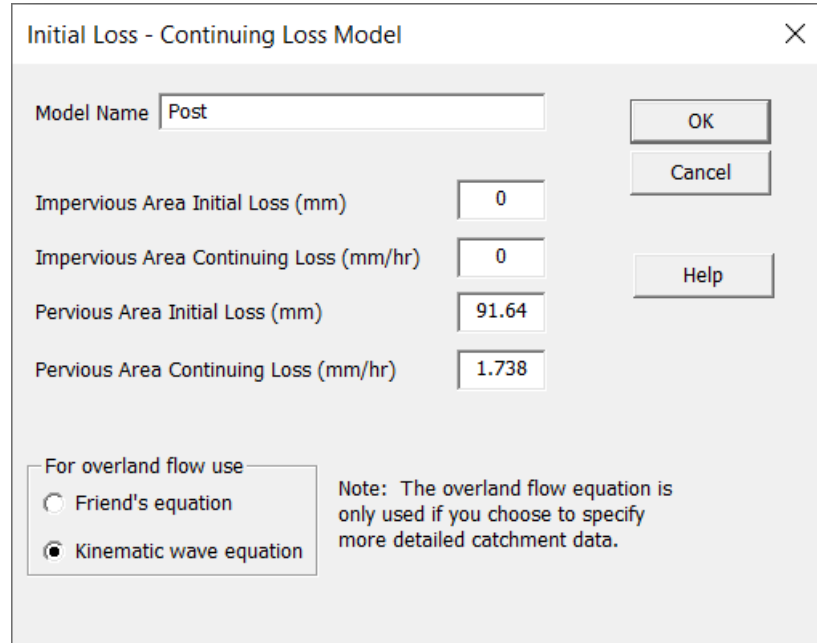
The catchment characteristics for the Post-Development catchment area can be seen in Table 3 below:

Construction Stage	Parameter	
Post-Development	Sub-Catchment Area	79,490.0 m ²
	Percentage Impervious	35.83 %
	Flowpath Length	69.25 m
	Flowpath Slope	2.89 %
	Retardance Coefficient 'n'	0.075

Table 3 – Proposed Development Catchment Parameters

To replicate the proposed site conditions and consider the available pervious areas located underneath the proposed arrays, the Pervious Area Initial and Continuing Loss was factored up by 1.58. This allowed the total pervious area to be included in the assessment.

The Hydrological model parameters used in the Post-Development model can be seen in Figure 5 below.



The dialog box titled "Initial Loss - Continuing Loss Model" contains the following fields and controls:

- Model Name:** A text box containing the word "Post".
- Buttons:** "OK", "Cancel", and "Help" buttons are located on the right side.
- Impervious Area Initial Loss (mm):** A numeric input box with the value "0".
- Impervious Area Continuing Loss (mm/hr):** A numeric input box with the value "0".
- Pervious Area Initial Loss (mm):** A numeric input box with the value "91.64".
- Pervious Area Continuing Loss (mm/hr):** A numeric input box with the value "1.738".
- For overland flow use:** A section containing two radio buttons:
 - ☐ Friend's equation
 - ☒ Kinematic wave equation
- Note:** A text area stating: "Note: The overland flow equation is only used if you choose to specify more detailed catchment data."

Figure 5 – Hydrological Model Parameters

The Results of the DRAINS model can be seen below in Table 4.

Construction Stage	Storm Event (Exceedance Probability / Annual Exceedance Probability)	Pre- Development Peak Flow	Post- Development Peak Flow	Difference
Post-Development	1EY	0.105 m ³ /s	0.082 m ³ /s	- 0.023 m ³ /s
	10% AEP	1.140 m ³ /s	0.555 m ³ /s	- 0.585 m ³ /s
	1% AEP	2.700 m ³ /s	1.850 m ³ /s	- 0.850 m ³ /s

Table 4 – Post-Development Peak Flow

4.2.3. Conclusion

By discharging the runoff from proposed Photovoltaic Array's directly to the existing ground surface and maintaining the existing natural surface levels and travel paths the proposed development area catchment limited the increase to peak runoff to negligible values, and reduced the peak runoff during the 1% AEP.

4.3. Gravel / Hardstand Area

The Gravel / Hardstand Area includes the proposed roads, gravel laydown area and temporary buildings located within the Investigation Area.

It is proposed that runoff from this area will generally follow the existing contours, with the existing earth berm to capture the runoff and convey these flows to a new above ground onsite stormwater detention basin. The basin will then reduce flows to the pre-development levels.

4.3.1. Pre-Development Peak Flows

The catchment characteristics for the Pre-Development catchment area can be seen in Table 5 below:

Catchment	Parameter	
Pre-Developed	Sub-Catchment Area	24,531.9 m ²
	Percentage Impervious	0 %
	Flowpath Length	188 m
	Flowpath Slope	3.3 %
	Retardance Coefficient 'n'	0.075

Table 5 – Existing Catchment Parameters

A DRAINS model was developed to determine the pre-development peak flow rates. The DRAINS model used the *ARR 2019 Initial loss - Continuing loss (IL-CL) hydrological model* and 2016 IFD data. The Hydrological model parameters were determined using the ARR data hub (see Figure 4 above) and was developed for the 1 EY (Exceedances per year), 10% AEP (Annual Exceedance Probability) and 1% AEP events.

The Results of the DRAINS model can be seen below in Table 6.

Catchment	Storm Event (Exceedance Probability / Annual Exceedance Probability)	Combined Peak Flow
Pre-Developed	1EY	0.028 m ³ /s
	10% AEP	0.243 m ³ /s
	1% AEP	0.685 m ³ /s

Table 6 – Pre-Development Peak Flow

4.3.2. Post-Development Peak Flows

The Post-Development site conditions can be summarised below:

- (i) The proposed gravel roads and hardstand areas will be assumed to be impervious.
- (ii) A retardance coefficient of 0.013 was adopted for both the proposed gravel road and hardstand area.
- (iii) The runoff from the impervious area was then treated as sheet flow along the natural ground surface and conveyed to the proposed above ground onsite stormwater detention basin via the existing earth berm.

The catchment characteristics for the Post-Development catchment area can be seen in Table 7 below:

Catchment	Parameter	
Hardstand	Sub-Catchment Area	686.56 m ²
	Percentage Impervious	100 %
	Flowpath Length	36.1 m
	Flowpath Slope	3.89 %
	Retardance Coefficient 'n'	0.013
Proposed Gravel Road	Sub-Catchment Area	973.91 m ²
	Percentage Impervious	100 %
	Flowpath Length	86 m
	Flowpath Slope	3.26 %
	Retardance Coefficient 'n'	0.013
Pervious	Sub-Catchment Area	23,210.6 m ²
	Percentage Impervious	0 %
	Flowpath Length	188 m
	Flowpath Slope	3.3 %
	Retardance Coefficient 'n'	0.075

Table 7 – Proposed Development Catchment Parameters

The Gravel / Hardstand Catchment drained directly into an above ground Onsite Stormwater Detention Basin. The Basin characteristics can be seen in Table 7 below.

OSD Basin	
Basin Invert	401.60m AHD
Basin – Top of Bank	402.0m AHD
Weir 1 Width	1.0 m
Weir 1 Level	401.80m AHD
Weir 2 Width	5.0 m
Weir 2 Level	402.00m AHD
Basin Volume	286.4m ³
Outlet Pipe (@ base)	225mm diam

Table 7 – Proposed OSD Basin Characteristics

The Results of the DRAINS model can be seen below in Table 8.

Storm Event	Pre-Dev. Peak Flow	Post-Dev. Peak Flow	Post-Dev. Peak Flow - Mitigated	Difference	Top Water Level
1EY	0.028 m ³ /s	0.060 m ³ /s	0.016 m ³ /s	- 0.012 m ³ /s	401.76m AHD
10% AEP	0.243 m ³ /s	0.280 m ³ /s	0.183 m ³ /s	- 0.060 m ³ /s	401.89m AHD
1% AEP	0.685 m ³ /s	0.703 m ³ /s	0.429 m ³ /s	- 0.256 m ³ /s	401.98m AHD

Table 8 – Post-Development Peak Flow

4.3.3. Conclusion

By discharging the runoff from proposed Gravel / Hardstand Area through the proposed OSD basin, the Post-development peak flows for the entire Investigation Area are reduced back to the Pre-development peak flow values.

5. Conclusion

The stormwater drainage strategy for the proposed Werris Creek Solar Farm at Black Gully Road, Werris Creek can be summarised as:

- (i) All impervious runoff from the proposed Photovoltaic Arrays will discharge to the existing ground surface where the natural flow regime will be maintained.
- (ii) Runoff from the proposed gravel/hardstand area catchment will be conveyed via sheet flow and the existing earth berm to the proposed above ground onsite stormwater detention basin.
- (iii) Discharge from the above ground onsite stormwater detention basing will be limited to the pre-development flow rates.

Provided the above stormwater drainage philosophy is adopted for the site, the proposed Werris Creek Solar Farm will limit the Post-Development peak flows to Pre-Development flow rates for the 1 EY, 10% AEP and 1% AEP events.

Should you require any further advice or clarification of any of the above, please do not hesitate to contact us.

Yours faithfully

DRB CONSULTING ENGINEERS PTY LIMITED



Mathew McNamara
BEng (Civil) Hons MIE Aust

TRAFFIC IMPACT ASSESSMENT

4.995MWAC - 5.2MWAC AGRIVOLTAIC SOLAR FARM

LOT 1 IN DP 509915
962 BLACK GULLY ROAD, WERRIS CREEK

PREPARED FOR: WYNERGY PTY LTD

AMENDED FEBRUARY 2021

20/101

**TRAFFIC IMPACT ASSESSMENT
WYNERGY PTY LTD****SOLAR PHOTVOLTAIC (PV) POWER FARM
LOT 1 IN DP 509915
962 BLACK GULLY ROAD, WERRIS CREEK**

Intersect Traffic Pty Ltd (ABN: 43 112 606 952)

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This document has been prepared, checked and released in accordance with the Quality Control Standards established by Intersect Traffic Pty Ltd.

Issue	Date	Description	By
A	03/09/20	Draft	JG
B	07/09/20	Traffic Data / Edit	JG
C	02/10/20	Final Proof	JG
D	02/10/20	Approved	JG
E	27/02/21	Access via Russell Street / Approved	JG

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This document has been authorised by


Date 27th February 2021**Disclaimer**

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1.0 INTRODUCTION

Intersect Traffic Pty Ltd (Intersect Traffic) has been engaged by KDC Pty Ltd on behalf of Wynergy Pty Ltd to prepare a traffic impact assessment report for a proposed Agrivoltaic (AV) Solar Power Farm (4.995MW to 5.2MW) on Lot 1 DP 509915 – 962 Black Gully Road, Werris Creek.

The proposed development involves installation of solar panel banks, transformers, inverters, meters and storage banks as well as an 11 KV underground line to a nearby powerline with a new power pole and T connection with 11KV feeder WC519. The site will also be provided with a new rural vehicular access and driveway with turnaround area to Black Gully Road just south of Anzac Parade, on-site car parking and temporary construction office.. The development concept plans are shown in **Attachment A**.

This report is required to support a development application to Liverpool Plains Shire Council and allow the Council to assess the proposal in respect of its impact on the local and state road network.

This report presents the findings of the traffic and parking assessment and includes the following:

1. An outline of the existing situation near the site.
2. Assessment of the additional traffic generated by the proposal, identifies a preferred delivery route and the additional traffic's impact on the local road network.
3. Review of the adequacy of the proposed vehicular access to the site.
4. Review of the suitability and provision of on-site car parking through assessment against Council and Australian Standards requirements.
5. Presentation of conclusions and recommendations.

2.0 SITE DESCRIPTION

The subject site is shown in **Figure 1** below. It is located on the eastern side of Black Gully Road, Werris Creek approximately 1.3 km's south-east of Russell Street and approximately 1.3 kilometres east of Werris Creek. The site currently contains agricultural paddocks and a dwelling with associated farm sheds that are not within the development area.

The property has the formal title of Lot 1 in DP 509915, 962 Black Gully Road, Werris Creek and the development area for the proposal is approximately 20 hectares. The site is currently zoned RU1 – Primary Production pursuant to the Liverpool Plains LEP (2011).

The existing main vehicular access to the site is provided to the unsealed section of Russell Street, Werris Creek via a single width rural access crossing to an existing dwelling and sheds which will remain as it is not within the development area. A new access off Black Gully Road (extension to Russell Street) 1.3 km's further south of the existing access will be constructed as part of the development. Deliveries to the site will use the identified delivery road shown on **Figure 1** being via the Pacific Motorway (M1), Hunter Expressway (M15), New England Highway (SH9) from Sydney or Newcastle to Willow Tree then via Kamilaroi Highway (SH29) to Quirindi, Werris Creek Road (MR 130) to Werris Creek and then via Russell Street to the site. **Photograph 1** below shows the development site from Black Gully Road while **Photograph 2** shows Russell Street / Black Gully Road near the site.

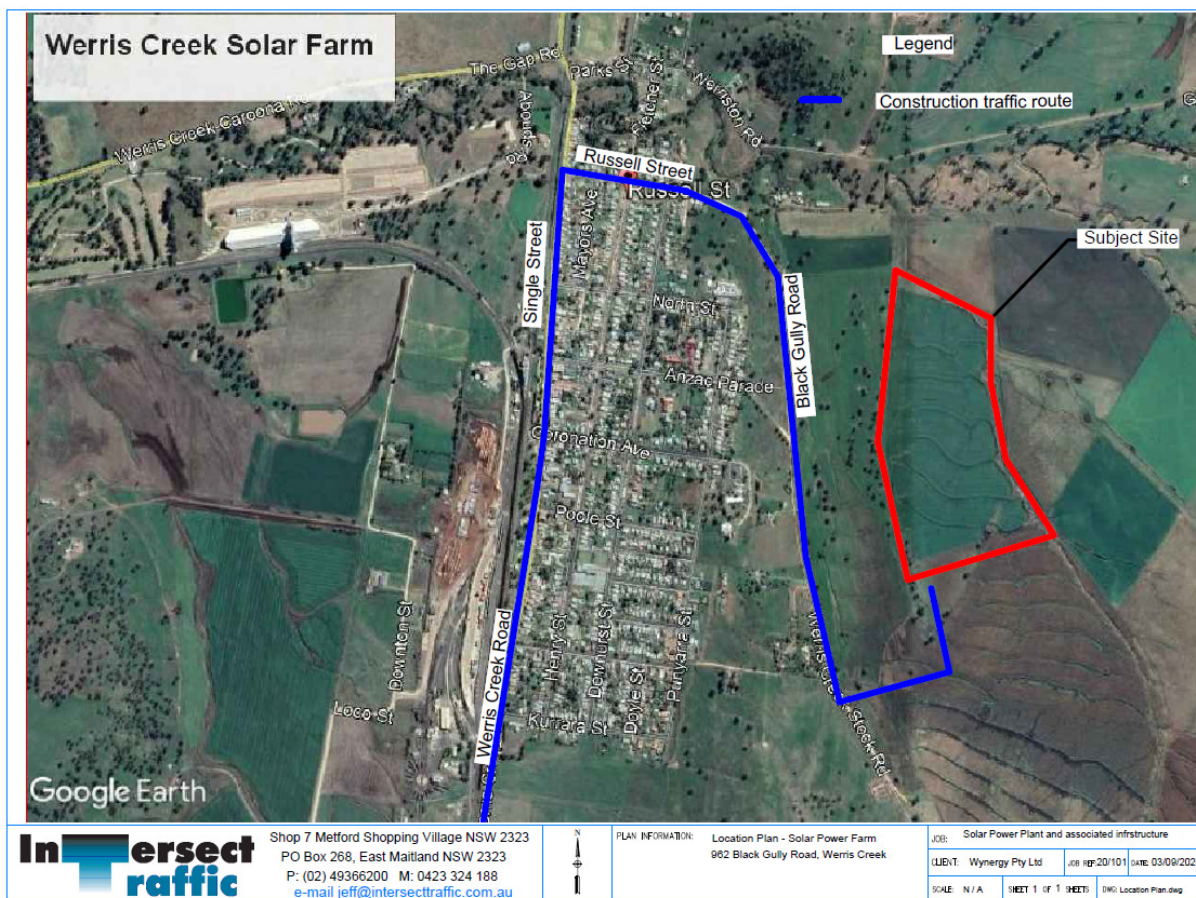


Figure 1 – Site Location



Photograph 1 – Development site from Black Gully Road



Photograph 2 – Black Gully Road near site

3.0 EXISTING ROAD NETWORK

Werris Creek Road

Werris Creek Road is a classified regional road (MR130) with its primary function to connect Tamworth to Quirindi through Werris Creek. As such it is local collector road under the care and control of Liverpool Plains Shire Council with some funding assistance from Transport for NSW (TfNSW). Through Werris Creek the road is known as Single Street.

Between Quirindi and Werris Creek the road is a two-lane two-way sealed rural road with a 9.5 metre wide sealed carriageway consisting of two 3.0 – 3.1 metre wide travel lanes and 1 to 2 metre wide sealed shoulders. Through Werris Creek the road has a more urban construction type with kerb and gutter along the developed side of the road and a 15 to 18 metre wide sealed pavement providing two 3.5 metre wide travel lanes and parking lanes on both sides of the road. Near the site through Werris Creek the speed zoning is 60 km/h while the rural sections of the road have a speed zoning of 100 km/h. At the time of inspection Werris Creek Road was observed to be in good condition suitable for heavy vehicle traffic as shown in **Photograph 3** below.



Photograph 3 – Werris Creek Road (Single Street), Werris Creek.

Russell Street

The most convenient construction traffic route to the site is via Russell Street to Black Gully Road. Russell Street is a local road under the care and control of Liverpool Plains Shire Council. Its main function is to provide access to properties along its length. Russell Street is an undivided two-lane two-way sealed urban road approximately 10 to 12 metres wide between Single Street and Dewhurst Street. Beyond Dewhurst Street towards Black Gully Road, Russell Street is a rural sealed road 6 metres wide for approximately 140 metres before becoming an unsealed road to Black Gully Road between 4.5 metres and 6 metres wide. It is only suitable for two-way traffic at low speeds and not suitable for frequent two-way flows as passing opportunities are limited. Russell Street is speed zoned as 50 km/h and at the time of inspection Russell Street was observed to be in good condition and suitable for heavy vehicle traffic as shown in **Photograph 4**

below. Russell Street connects to Werris Creek Road (Single Street) as a priority controlled give way T-intersection.



Photograph 4 – Russell Street, Werris Creek.

Black Gully Road

Black Gully Road is a local unsealed rural road with the primary function of providing access to properties along its length. As a local rural road it is under the care and control of Liverpool Plains Shire Council. A 50 km/h speed zoning is in effect near the urban area and with a carriageway width of only 5 metres low speeds are generally experienced in the area. There are sections of the road which would allow two way traffic flow or passing opportunities to maintain two way flow but generally it is not suitable for the frequent two way flow of heavy vehicles, as shown in **Photograph 2** and **Photograph 5** below, even though it would satisfy NSW Rural Fire Service standards for access.



Photograph 5 – Black Gully Road.

4.0 ALTERNATIVE TRANSPORT MODES

In terms of public transport Werris Creek is serviced by a private bus service (Tamworth Buslines) and heavy rail through Werris Creek Station which is located approximately 1.8 km south-west of the site. Tamworth Buslines runs route 428 (Tamworth – Quirindi) through Werris Creek (see **Figure 2**). This provides three am and three pm services each way on weekdays only therefore is limited in its services. A separate single shoppers service from Werris Creek also runs every second Thursday. Bus stops are located on Single Street near Anzac Parade and Russell Street still some 1.3 km's from the site. Train services to Werris Creek include the daily Central to Armidale service each way and a daily service from Werris Creek to Moree.

Neither of these public transport services are convenient to the site and would be of little benefit during the construction of the solar farm.

As a rural area there are no pedestrian footpaths within the local road network except within the Werris Creek township and only along the developed side of Single Street (Werris Creek Road) as shown below in **Photographs 6 & 7** below. Pedestrians are generally required to utilise the grass verges and road shoulders when walking in the area. These facilities are again unlikely to be of any benefit for reducing vehicle trips during the construction of the solar farm.

There are no off-road or on-road cycleway paths within the local road network. Cyclists are required to utilise the road verge or the road pavement and share travel lanes with other vehicles when cycling in the area.

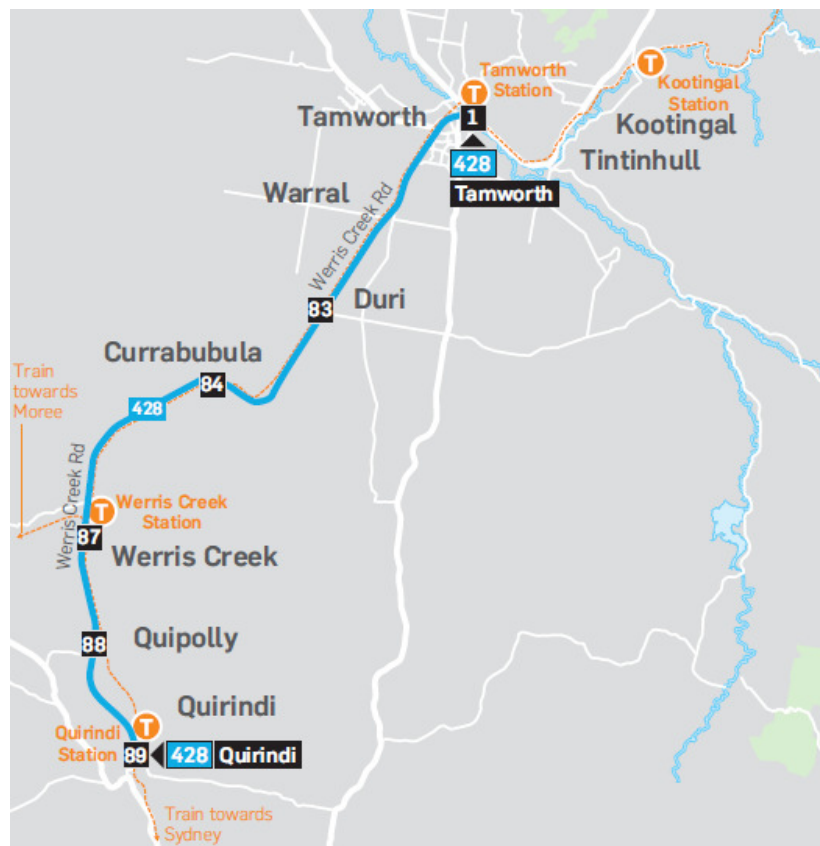


Figure 2 – Tamworth Buslines Regional Routes

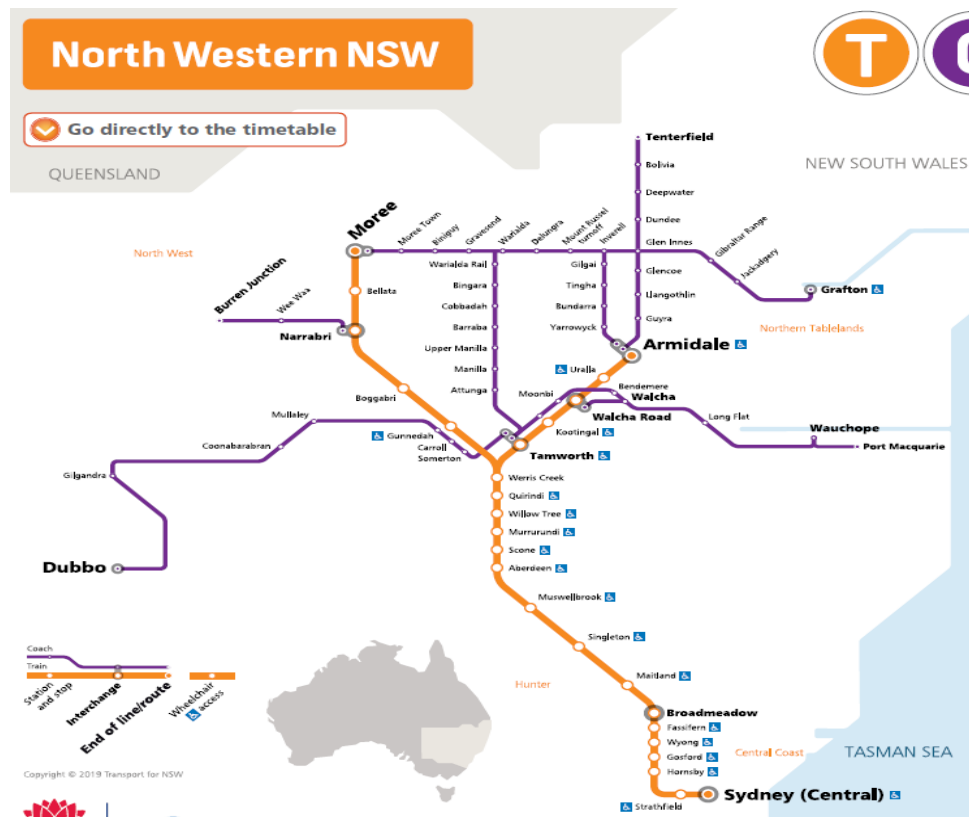


Figure 3 – NSW Trainlink routes through Werris Creek



Photograph 6 – Pedestrian footpath Single Street, Werris Creek.

5.0 DEVELOPMENT PROPOSAL

The proposed development involves the construction of a Solar Agrivoltaic (AV) Power Farm on the site. The development concept plans are shown in **Attachment A** with the specific works involved in the expansion listed below:

- Installation of temporary construction office and amenities.
- Installation of Solar Panel arrays.
- Earthworks for construction lay-down area, hardstand areas and internal road.
- Installation of inverter, transformers and meters.
- Construction of unsealed access road from Black Gully Road.
- Construction of an 11 KV underground line to a nearby powerline on Black Gully Road with a new power pole and T connection with 11KV feeder WC519
- Construction of security fence and entrance gate; and
- Drainage and landscaping to Liverpool Plains Shire Council requirements.

The development will require a team of 30 construction employees for a period of up to 6 months working 7 am to 5 pm Monday to Saturday. The majority of traffic movements associated with the development will occur during the construction of the solar power farm. Traffic movements generated by the operation of the development would include a single staff light vehicle movement associated with maintenance inspections as required and specific maintenance work which would be short term and infrequent. Deliveries during construction works would be expected to be within rigid and articulated vehicles. More detail on construction traffic is provided later in this report.



6.0 TRAFFIC IMPACTS

6.1 – Traffic Generation and Trip Distribution

The TfNSW publication “*RTA’s Guide to Traffic Generating Developments (2002)*” provides advice on the traffic generating potential of different land uses. However this document does not cover Solar Farms therefore determining traffic generation is reliant on advice from the applicant regarding construction and operation of the development.

From an operational perspective traffic generation is expected to be minimal with only regular daily maintenance inspections carried out when necessary. Therefore based on 1 visit per day per week a peak hour traffic generation of 2 vehicle trips per hour (vtpH) has been assumed for this assessment. There may be times when specific maintenance tasks have to be undertaken but these will be infrequent, short-term and undertaken under a construction traffic management plan for the work.

Construction traffic estimates for the development are as follows based on the information provided by the client.

- Construction employees on-site – Maximum 30 transported in up to 10 light vehicles per day arriving between 6 am and 7 am and departing between 5 pm and 6 pm.
- Deliveries – Mainly heavy rigid vehicles and articulated vehicles (AV). Maximum – 8 per day but average of 5 per day between 10 am and 4 pm. Whilst these are likely to mostly arrive outside the peak hour traffic generation periods associated with the arrival and departure of employees, logistically there could be occurrences when due to circumstances out of the control of the contractor, a delivery arrives during these peak hour periods.
- Other vehicles – Some earthworks plant may be required on-site as well as concrete agitators and road base material deliveries during construction of the access. It would be expected a maximum frequency of 3 deliveries within a peak hour is assumed.
- Construction period – up to 6 months.

The likely peak hour traffic generation which will occur in the AM peak coinciding with employees arriving on site and in the PM peak coinciding with employees leaving the site is calculated below. It is also noted deliveries involve 2 trips with an inbound trip and an outbound trip.

AM peak = 10 inbound employees + 3 x 2 roadworks and other plant + 1 x 2 deliveries = 18 vtpH (14 inbound and 4 outbound).

PM peak = 10 outbound employees + 3 x 2 roadworks and other plant + 1 x 2 deliveries = 18 vtpH (14 outbound and 4 inbound).

It is expected that the distribution of trips will be 100 % south to and from Quirindi as well as Newcastle and Sydney from which all deliveries will originate. In accessing the site the likely transportation route as envisaged is shown on the location plan (**Figure 1**).

Existing traffic volumes in the area were recorded by Intersect Traffic at the Werris Creek Road (Single Street) / Russell Street intersection during the likely peak am and pm traffic periods i.e. 8 am – 9 am and 4.00 pm – 5.00 pm on Tuesday 11th August 2020 and Wednesday 12th August 2020. These periods were chosen following interrogation of TfNSW data in the area on its Traffic Volume Viewer application. The data sheets for these counts are provided in **Attachment B**.

These traffic counts determined that the relevant peak hour two-way traffic volumes on the state and local road network in the AM and PM periods during this period were.

- Werris Creek Road north of Russell Street - 195 vtpH in the AM peak and 223 vtpH in the PM peak

- Werris Creek Road south of Russell Street – 194 vtp/h in the AM peak and 211 vtp/h in the PM peak.
- Local road network at Russell Street – 19 vtp/h in the AM peak and 24 vtp/h in the PM peak.

Given the construction will be completed within a 6 month period and the peak operational traffic volume from the site is only 2 vtp/h there is no need to do a 2030 (10 year horizon period) assessment of this development.

6.2 – Road Capacity

Table 4.5 of the “RTA’s Guide to Traffic Generating Developments” provides some guidance on likely levels of service being experienced on two-lane two-way rural roads for different terrain types. This table is reproduced below in **Table 1**:

In determining the capacity of the state and local road network from this table the following has been considered:

- The terrain level for the area surrounding the site is considered to satisfy the criteria for level terrain.
- 10% heavy vehicle traffic on the road has been assumed: and
- A Level of Service (LoS) C is considered the acceptable LoS for a rural road and a LoS C exists up to the threshold for a LoS D.

On this basis, the likely mid-block two-way road capacity for the state and local road network is approximately 1,480 vtp/h though in regard to the local road network i.e. Russell Street / Black Gully Road it is more appropriate to apply the environmental capacity guidelines set by TfNSW in Table 4.6 of its “RTA’s Guide to Traffic Generating Developments” (see below in **Table 2**), given the standard of construction of these roads and their primary function of providing access to properties / dwellings along their length.

Table 1 – Rural Road Capacity Table

Table 4.5
peak hour flow on two-lane rural roads (veh/hr)
(Design speed of 100km/hr)

Terrain	Level of Service	Percent of Heavy Vehicles			
		0	5	10	15
Level	B	630	590	560	530
	C	1030	970	920	870
	D	1630	1550	1480	1410
	E	2630	2500	2390	2290
Rolling	B	500	420	380	310
	C	920	780	650	570
	D	1370	1140	970	700
	E	2420	2000	1720	1510
Mountainous	B	340	230	180	150
	C	600	410	320	280
	D	1050	680	500	400
	E	2180	1400	1040	820

The data for Table 4.5 assumes the following criteria:

- terrain level with 20% no overtaking.
- rolling with 40% no overtaking.
- mountainous with 60% no overtaking.
- 3.7 m traffic lane width with side clearances of at least 2m.
- 60/40 directional split of traffic.

Source: - RTA’s Guide to Traffic Generating Developments (2002)

Table 2 – Environmental Road Capacity Table

Table 4.6
Environmental capacity performance standards on residential streets

Road class	Road type	Maximum Speed (km/hr)	Maximum peak hour volume (veh/hr)
Local	Access way	25	100
	Street	40	200 environmental goal
			300 maximum
Collector	Street	50	300 environmental goal
			500 maximum

Note: Maximum speed relates to the appropriate design maximum speeds in new residential developments. In existing areas maximum speed relates to 85th percentile speed.

Source: - RTA's Guide to Traffic Generating Developments (2002)

Based on this table it is considered that traffic volumes on Russell Street and Black Gully Road should not exceed 200 vph.

Therefore the road capacity thresholds adopted in this assessment are as follows.

- Werris Creek Road (Single Street) – 1,480 vph.
- Russell Street (Black Gully Road) – 200 vph.

The two-way mid-block peak hour traffic data and traffic generation figures reported in **Section 6.1** in the AM and PM peak hour traffic volumes on the local and state road network during construction of the Solar Farm are still well below the existing capacity thresholds determined above. Therefore, the local and state road network has sufficient spare two-way capacity to cater for the construction and operation of the Solar Farm. The addition of up to 18 vph will not cause the capacity thresholds determined above to be reached therefore it can be concluded that the proposed development will not adversely impact on the local and state road network efficiency during construction.

6.3 – Intersection Capacity

Based on the traffic volume data collected for the project, it has been determined that even during construction and post development, traffic volumes on the local and state road network are less than the traffic volume thresholds identified within Austroads *Guide to Traffic Management Part 6 – Intersections, Interchanges and Crossings* (2010), reproduced below in **Table 3**. where the Guide state that if traffic volumes are not above these thresholds, then uninterrupted flow conditions can be assumed and little or no delay will be experienced by motorists at these intersections. No further intersection analysis is then required.

Table 3 – Uninterrupted flow condition thresholds at an intersection

Major road type ¹	Major road flow (vph) ²	Minor road flow (vph) ³
Two-lane	400	250
	500	200
	650	100
Four-lane	1000	100
	1500	50
	2000	25

Source: - Austroads Guide to Traffic Management – Part 6: Intersections, Interchanges and Crossings (2010).

Peak traffic volumes on all intersections along the transportation route will remain with major road flows less than 260 vtpd and minor road traffic volumes less than 50 vtpd post development. These intersections will therefore remain operating with uninterrupted flow conditions with little if any delay for motorists. This also means that no special lane treatments are required at the proposed site access and a normal heavy duty rural access would be sufficient for the development.

Overall it can be concluded that the proposed Solar Farm at the site will not adversely impact on the efficiency and effectiveness of the local and state road network either during construction or once operational.

6.4 Access Assessment

In terms of the width of the vehicular access to the development, which provides access to a user class 1 (long term) car parking facility with less than 25 car spaces fronting a local road, the access is required to be a category 1 access (Table 3.1 of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking*). Table 3.2 of the Standard then specifies a category 1 access facility as a combined entry / exit between 3.0 to 5.5 metres wide. However the proposed entrance width at the combined entry / exit access at Black Gully Road will need to be a minimum 12.5 metres wide to cater for the swept turning paths for delivery vehicles during construction stage and satisfy the requirements of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking* and Australian Standard *AS2890.2-2002 Parking Facilities – Part 2 Off-street commercial vehicle facilities*.

Sight distance at the proposed access off Black Gully Road was observed to be in excess of 200 metres in each direction therefore complies with the requirements of Figure 3.2 of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking (160 metres desirable for 100 km/h)*.

It is therefore concluded that the proposed site access is suitably located and satisfactory for use for the Solar Farm as it complies with the requirements of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking* and Australian Standard *AS2890.2-2002 Parking Facilities – Part 2 Off-street commercial vehicle facilities*.

The main issue with access for construction vehicles to the site is the suitability of the local road network to safely cater for heavy vehicle deliveries. Intersect Traffic during a site inspection undertook a preliminary assessment of the roads and identified the following recommended conditions noting traffic volumes on Black Gully Road is extremely low (< 10 vtpd).

1. Articulated vehicles to be piloted in and out of the site from the end of the sealed section of Russell Street given the narrow width and standard of Black Gully Road. This could be included as a condition of consent and thereby negate the need for expensive road upgrades for a temporary traffic loading.
2. A dilapidation report is to be prepared on completion of construction to identify damage caused by construction of the solar farm and for Council and the contractor to mutually agree to works to be undertaken to rectify any damage. This will require a pre-construction and post construction inspection by Council with the contractor to agree on a baseline condition of the road network prior to construction as well as the post development condition; and
3. These measures and other special strategies should form part of a Construction Traffic Management Plan for the development that should be prepared by the contractor and submitted to Council for endorsement prior to commencement of construction.

Overall with suitable conditions of consent included for special travel conditions the proposed local and state road network would be considered suitable to cater for the expected construction traffic associated with the development.

7.0 ON-SITE CAR PARKING

On-site car parking for the proposal is required to comply with the Industrial Development controls within Liverpool Plains Shire Council's Guyra DCP (2012). Adopting the industrial development rates for this project the relevant on-site car parking provision during the operation of the Solar Farm is.

▮ *1 space per 75 m² or 1 space per 2 employees whichever is greater*

With no buildings on the site and only 1 employee likely to be engaged in the day to day operation of the Solar Farm the development is only required to provide 1 on-site car parking space.

However it is the responsibility of the applicant to also provide sufficient on-site car parking for construction and maintenance employees during the duration of the construction and operation of the development for the development to comply with the car parking objectives of the DCP. The site plan shows provision of a construction laydown area with provision to accommodate at least the expected construction employee vehicle generation of 10 vehicles which is also in excess of the Industrial land use requirements of the Liverpool Plains Council DCP (2012). With significant overflow parking areas also on site it is considered reasonable to conclude the development provides sufficient on-site car parking that complies with the objectives and controls related to car parking required within the Liverpool Plains Council DCP (2012).

A review of the development plans indicates the car parking area is sufficient in size such that parking bays and aisle widths would comply with the requirements of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking* and this could be suitably conditioned on the consent for inclusion in Construction Certificate drawings. Therefore the on-site car parking is considered suitable for the development ensuring all vehicle movements to and from the site off Black Gully Road will be undertaken in a forward direction.

8.0 ALTERNATE TRANSPORT MODES

The proposed development will not generate any increase in public transport demand during both the construction and operational phases of the development. Therefore there is no nexus for the provision of new services or improved infrastructure resulting from the development. Similarly, the development will not generate any additional pedestrian or cycle traffic therefore no nexus exists for the provision of additional pedestrian paths or cycle ways near the site.



9.0 CONCLUSIONS

This traffic and parking assessment for the proposed Solar Agrivoltaic (AV) Power Farm (up to 5.2 MW) on Lot 1 DP 509915 – 962 Black Gully Road, Werris Creek has determined the following:

- The development during construction will generate up to an additional 18 vehicle movements to and from the site during the weekday AM and PM peak periods but only 2 vtpd during the operation of the Solar Farm.
- The existing peak traffic volumes on the local road network are well below the two-way mid-block capacity threshold of 1,480 vtpd for Werris Creek Road and as well as the environmental capacity of 200 vtpd for the local road network (Russell Street and Black Gully Road). Traffic volumes will remain below these thresholds during the construction and operation of the development.
- All intersections along the main transportation route from the New England Highway at Willow Tree to the site will continue to operate satisfactorily and with uninterrupted flow conditions with little if any delay to motorists during construction and post development.
- Therefore, the additional construction and operational traffic generated by this development will not adversely impact on the efficiency or effectiveness of the local and state road network.
- The proposed site access is suitable for use for construction and operation of the development being compliant with Australian Standard and Austroads requirements.
- The access route to the site from Werris Creek Road will require some appropriate conditions of consent regarding special travel conditions for heavy vehicles (piloting into the site) and commitments to repair damage post construction (dilapidation report) to be suitable for the short term traffic loading resulting from the construction of the development.
- These special travel measures for heavy vehicles and the preparation of a dilapidation report for the transportation route from Werris Creek Road to the site should be included in a Construction Traffic Management Plan for the development that should be prepared by the contractor and submitted to Council for endorsement prior to commencement of construction.
- There is sufficient area on-site to accommodate the expected peak parking demand generated by the development during both construction and operation with the provision of an AS2890.1-2004 compliant car park within the construction laydown area for a minimum 10 spaces as well as the provision of numerous overflow parking areas on the site.
- The proposed development will not generate any increase in public transport demand therefore no nexus exists for the provision of new services or improved infrastructure resulting from the development. Similarly, the development will not generate any additional pedestrian or cycle traffic therefore no nexus exists for the provision of additional pedestrian paths or cycle ways near the site.

10.0 RECOMMENDATION

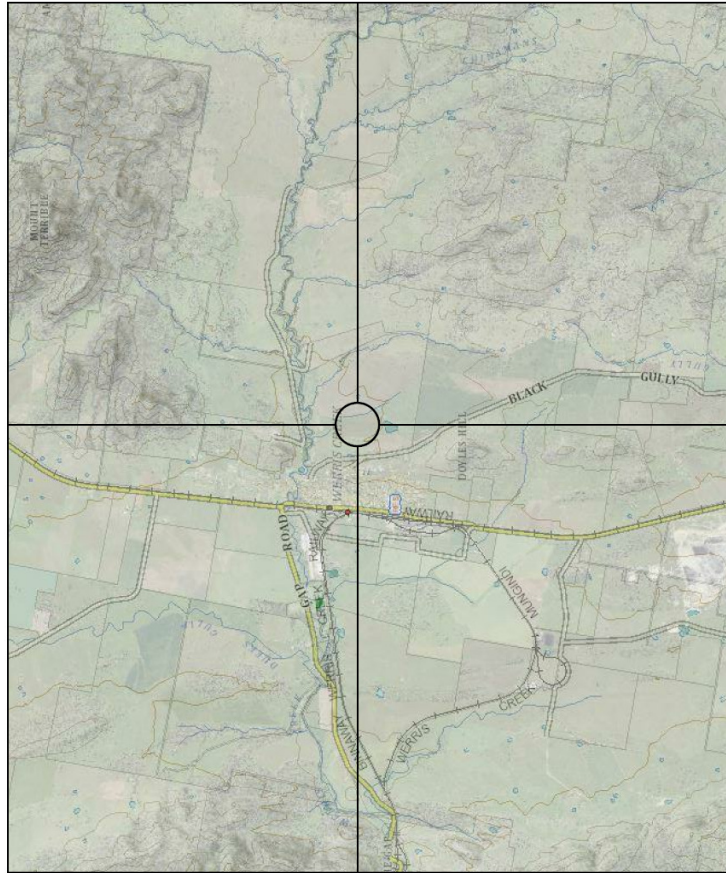
Having carried out this traffic and parking assessment for the proposed Solar Agrivoltaic (AV) Power Farm (up to 5.2 MW) on Lot 1 DP 509915 – 962 Black Gully Road, Werris Creek it is recommended that the proposal can be supported from a traffic perspective as the development will not adversely impact on the local road network and complies with all relevant requirements of Liverpool Plains Shire Council, Austroads, Australian Standards and NSW RMS.



JR Garry BE (Civil), Masters of Traffic
Director
Intersect Traffic Pty Ltd

ATTACHMENT A DEVELOPMENT PLANS

LOT 1 DP 509915 BLACK GULLY ROAD WERRIS GREEK NSW 2341



Sheet List				
Sheet Number	Sheet Name	Current Revision	Current Revision Description	Current Revision Date
A01	COVER SHEET	5	DATE PUBLICATION	21/09/20
A02	SITE PLAN	5	DATE PUBLICATION	21/09/20

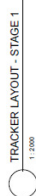
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DA APPLICATION

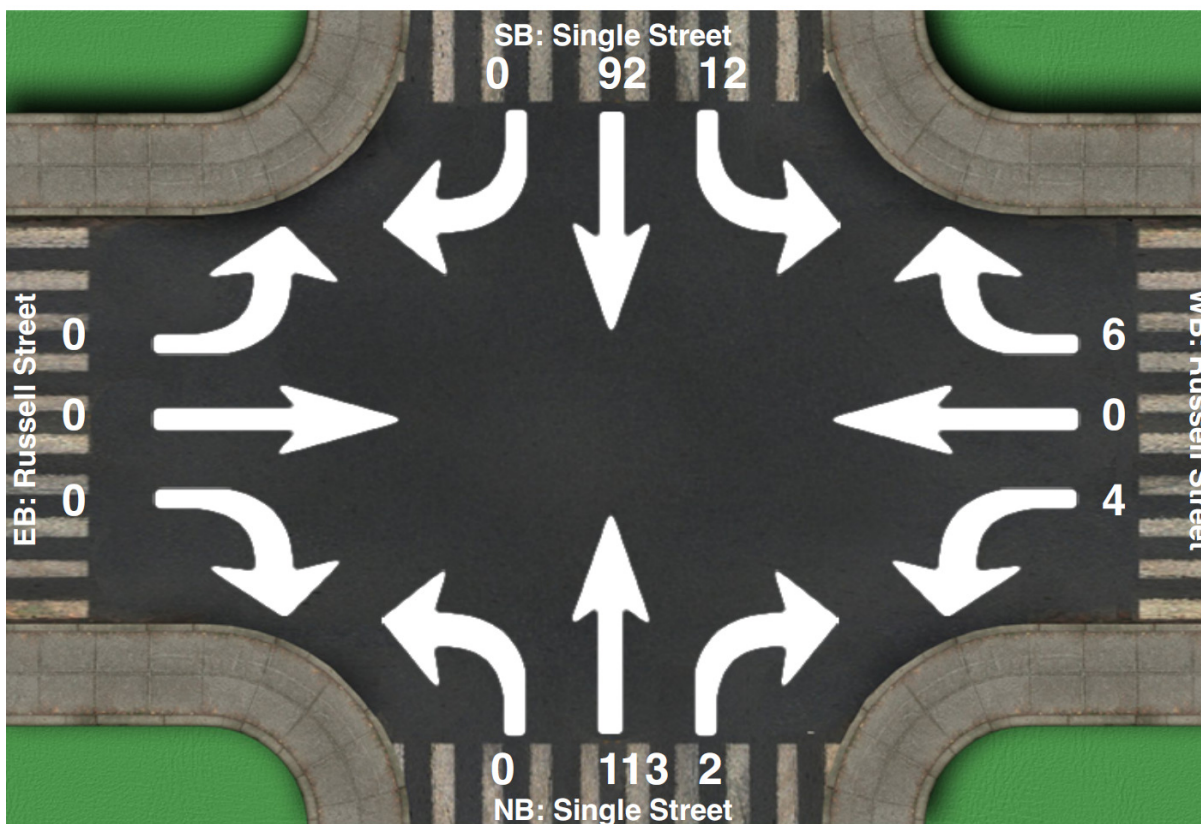
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ATTACHMENT B

TRAFFIC COUNT DATA

Intersection Peak Hour

Location: Single Street at Russell Street, Werris Creek
 GPS Coordinates:
 Date: 2020-08-11
 Day of week: Tuesday
 Weather:
 Analyst: Imogen



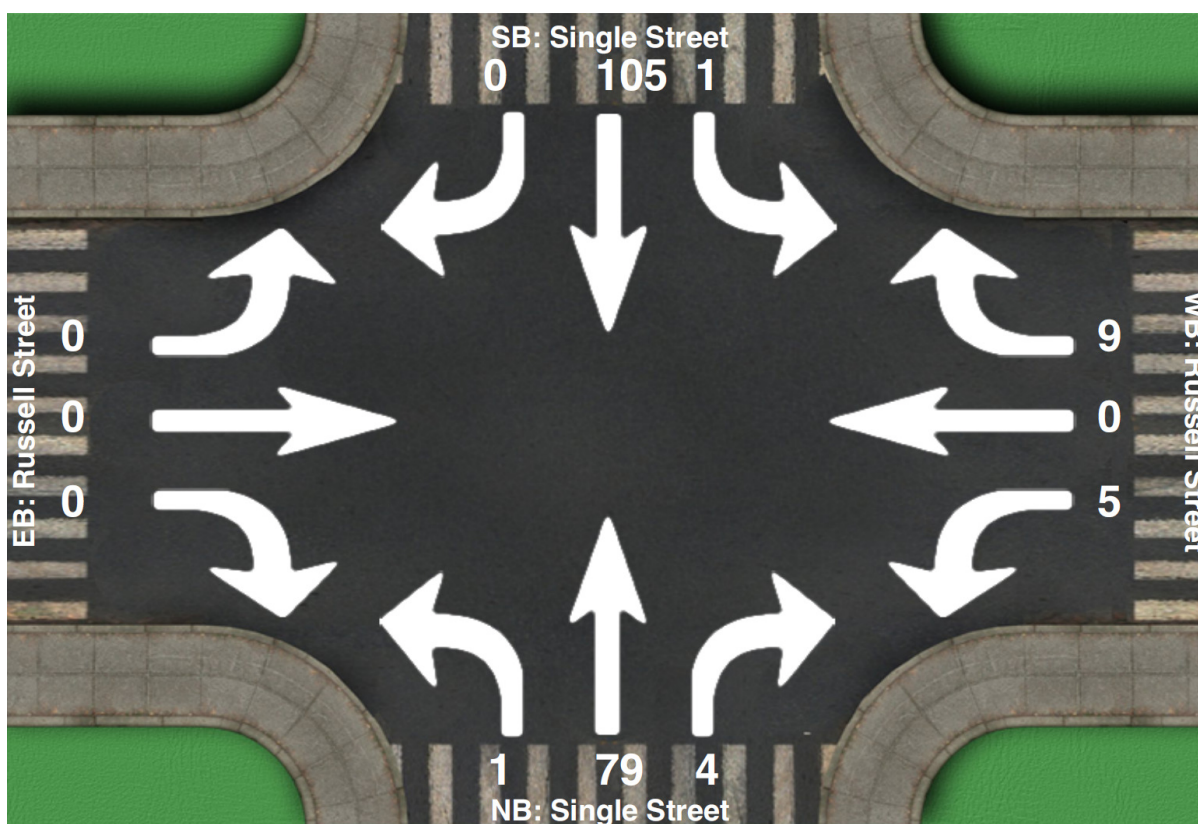
Intersection Peak Hour

16:00 - 17:00

	SouthBound			Westbound			Northbound			Eastbound			Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Vehicle Total	12	92	0	4	0	6	0	113	2	0	0	0	229
Factor	0.50	0.66	0.00	0.50	0.00	0.50	0.00	0.83	0.50	0.00	0.00	0.00	0.78
Approach Factor	0.70			0.62			0.82			0.00			

Intersection Peak Hour

Location: Single Street at Russell Street, Werris Creek
 GPS Coordinates:
 Date: 2020-08-12
 Day of week: Wednesday
 Weather:
 Analyst: Imogen



Intersection Peak Hour

08:00 - 09:00

	SouthBound			Westbound			Northbound			Eastbound			Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Vehicle Total	1	105	0	5	0	9	1	79	4	0	0	0	204
Factor	0.25	0.60	0.00	0.62	0.00	0.45	0.25	0.82	0.50	0.00	0.00	0.00	0.70
Approach Factor	0.59			0.70			0.81			0.00			



MOSS
ENVIRONMENTAL

Visual Impact Assessment – Menz Solar Farm

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Rev	Date	Author	Reviewed by	Approved by Name & Signature	Remarks
A	16/9/2020	S. Gleeson-Willey	Warrick Giblin And Ben Wynn	S. Gleeson-Willey	Comments received; report updated.
1	24/9/2020	S. Gleeson-Willey	Ben Wynn		Updated design plans incorporated
2	28/9/2020	S. Gleeson-Willey		S. Gleeson-Willey	Final

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This Report has been prepared by Moss Environmental at the request of Wynergy Pty Ltd. This report provides Environmental mitigation and measures to help ensure compliance with relevant environmental legislative requirements, before, during and after works commence.

It is intended that this document will be used by Wynergy and any appointed contractor for the purposes of the Proposal as described herein. This document is not intended to be utilized or relied upon by any other persons, nor to be used for any other purpose other than that articulated above. Accordingly, Moss Environmental accepts no responsibility in any way whatsoever for the use of this report by any other persons or for any other purpose.

The information, statements, recommendations, and commentary contained in this review have been prepared by Moss Environmental from material provided by Wynergy Pty Ltd, specialist sub-consultants engaged by Wynergy Pty Ltd and through the site investigation process. Moss Environmental has not sought any independent confirmation of the reliability, accuracy, or completeness of this information. It should not be construed that Moss Environmental has carried out any form of audit or the information which has been relied upon.

Accordingly, whilst the statements made in this report are given in good faith, Moss Environmental accepts no responsibility for any errors in the information provided by Wynergy Pty Ltd or its subcontractors, nor the effect of any such errors on the analysis undertaken, suggestions provided or this report.

EXECUTIVE SUMMARY

This Visual Impact Assessment (VIA) has considered the potential environmental impacts associated with the proposal to construct a 5MW solar Farm on an agricultural property in Werris Creek, NSW.

The VIA has examined and considered to the fullest extent possible all matters affecting or likely to affect the visual amenity and landscape character by reason of the proposed activity.

After mitigation measures are applied no high visual impacts would result from the project. The western site boundary of the proposed solar farm is to be targeted for additional vegetation screening to mitigate cumulative impacts and lessen the contrast of the infrastructure given the proximity and elevated position of residential properties. Refer to the Landscaping Plan (Wynergy 2020) for planting locations. The proposed planting, which includes sections of perimeter planting as well as groves, could assist to break up the views of the infrastructure and would also address cumulative impacts of this infrastructure to maintain the landscape character and avoid a more industrial character becoming dominant. Mitigation measures as detailed in this VIA would ameliorate or minimise these expected impacts. The proposal would also improve regional energy capabilities, and provide construction and operational jobs. On balance the proposal is considered justified.

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TERMS AND ACRONYMS

Table 1: Terms and Acronyms

Abbreviation	Description
Aesthetics	Relating to the sense of the beautiful or science of aesthetics, ie the deduction, from nature and taste, the rules and principles of beauty
Desired future character	A term used to capture the desirable future outcome or vision for an area as set down in planning or as professionally assessed and envisaged by urban designers or other built environment professionals.
EP&A Act	Environmental Planning and Assessment Act 1979
Impact	The effect of a proposal, which can be adverse or beneficial, when measured against an existing condition.
Impact Assessment	Broadly, the process of describing and characterising the expected effects of a proposal. In the context of an EIS or REF or SEE, impact assessment will also lead to the identification of mitigation measures and safeguards which would be addressed if the proposal were approved.
Landscape	All aspects of a tract of land, including landform, vegetation, buildings, villages, towns, cities and infrastructure
Landscape character	The combined quality of built, natural and cultural aspects which make up an area and provide its unique sense of place.
Landscape character unit (LCU)	LCUs take into account topography, vegetation, land use, and other distinct landscape features. They are a way to categorise the existing scenic quality of the receiving environment and consider the ability of the environment to absorb visual change at the landscape scale.
Landscape character zone	An area of landscape with similar properties or strongly defined spatial quantities, distinct from areas immediately nearby.
Landscape character type	Multiple similar landscape character zones repeated within a larger study area, grouped to avoid repetition in their description
Landscape Management Zone (LMZ)	LMZs are derived by combining scenic quality with viewer sensitivity and proximity to the proposed infrastructure at the landscape scale. A three-tiered management hierarchy sets out appropriate management objectives for each zone.
Magnitude	The measurement of the scale, form and character of a development proposal when compared to the existing condition. In the case of

	visual assessment this also relates to how far the proposal is from the viewer. Combined with sensitivity, magnitude provides a measurement of impact.
Place	A 'Place' is an area of the landscape of any size, that has a certain unique quality relating to the natural, built, cultural or community context, with a clear identity and 'sense of place'.
Project	All infrastructure and activities required for the construction, operation and decommissioning of the solar farm.
Sensitivity	The sensitivity of a landscape character zone or view and its capacity to absorb change of the nature of the proposal. In the case of visual impact this also relates to the type of viewer and number of viewers. Combined with magnitude, sensitivity provides a measurement of impact.
Significant	In the context of EIA, after analysing the extent (type, size, scope, intensity and duration) and nature (predictability, resilience of the environment, reversibility, ability to manage/mitigate, level of public interest) of a proposal, an expected level of impact of a proposal which requires an EIS to be undertaken. The term should be avoided in landscape character and visual impact assessments if the expected level of impact is below this threshold.
Solar farm site / site	The lot boundaries within which the solar farm development is proposed, excluding offsite infrastructure such as transmission lines and connections.
Study Area	Defined as within 15km of the proposed solar farm site.
VEM	A Visual Envelope Map, also referred to as 'viewshed' or 'visual catchment', is the area within which a project can be seen at eye level above ground. Its extent will usually be defined by a combination of landform, vegetation and built elements.
View	The sight or prospect of a landscape or scene
Viewer sensitivity	Subjective but can be assumed based on factors such as whether the view relates to recreational or work environments, or whether the view is experienced continuously or intermittently.
Visibility	The state or fact of being visible or seen.
Visual Impact	The impact on the views from residences, workplaces and public places.
Viewshed	The modelling resulting from modelling the area within which a project can be seen at eye level above ground. Its extent will usually be defined by a combination of landform,

	vegetation and built elements.
Zone of Visual Influence (ZVI)	ZVI modelling uses GIS modelling and topography to determine areas which would be sheilded from views of infrastructure at the proposed solar site. It does not take into account other existing or proposed screening features such as vegetation or built structures.

1. INTRODUCTION

1.1. Project Identification

The Menz Solar Farm (SF) proposal site is located on the eastern side of Black Gully Road, in Northern NSW within the Liverpool Plains Shire Council area (LGA). The Menz SF proposal comprises the installation of a solar plant with an upper capacity of 5MW that would supply electricity to the National Electricity Market (NEM). The power generated would be transmitted via overhead powerline to the existing substation of Black Gully Road.

- The proposal would comprise an array of solar panels covering an area of approximately 8 hectares, and related infrastructure as follows;
- Underground 11Kv cable beneath the access track through to the overhead 11kv feeder WCK519 on Black Gully Road for grid connection to the adjacent substation (existing);
- Solar photovoltaic (PV) modules mounted on a horizontal tracking structure;
- Overhead or underground electrical conduits and cabling to connect the arrays on the array site;
- An onsite substation containing one transformer and associated switchgear;
- Internal inverter stations to allow conversion of DC module output to AC electricity;
- Internal access tracks to allow for site maintenance;
- Perimeter security fencing;

During the construction period some additional temporary facilities would be located within the site boundary and may include;

- Material laydown areas;
- Temporary construction site offices and toilet;
- Temporary car parking areas for construction worker's transportation. Once the plant has been commissioned, a small car park will remain for the minimal staff and occasional visitor.

Refer to section 4 for more detail on the visual character of these temporary facilities.

The Menz SF would be expected to operate for approximately 30 years. The construction phase of the proposal would take approximately 6 months. After the initial 30-year operating period, the solar farm would either be decommissioned, removing all above ground infrastructure associated solely with the SF and returning the site to its existing land

capability, or repowered with new PV equipment. The proposal is considered highly reversible with regard to land capability and land use options including sheep grazing beneath the PV panels whilst in operation.

An indicative layout is shown in Appendix A. Detailed design may lead to some minor layout changes. The layout shown represents the maximum impact areas that would be required.

1.2. Objectives of This Report

This Visual Impact Assessment includes a full assessment of the visual impacts associated with the proposed Menz Solar Farm. Specifically, it includes an assessment of:

- Landscape character and scenic vistas in the locality;
- Stakeholder values regarding visual amenity;
- Potential impacts on representative viewpoints, including residences and road corridors.

2. METHODOLOGY

2.1. OVERVIEW

The visual Impact Assessment has been completed following the steps below;

- Background investigations, mapping, and modelling;
- Field survey including reconnaissance, ground truthing and photography;
- Impact assessment;
- Development of a visual impact mitigation strategy.

These methods are detailed below.

2.2. BACKGROUND INVESTIGATIONS, MAPPING AND MODELLING

Background investigations including identifying key landscape features within the landscape that may be affected by the visual impacts of the proposed solar farm. This was done using existing literature and aerial photos.

Mapping and modelling were undertaken to:

- Identify and classify LCUs within 15km of the proposed solar farm. This was done based on aerial imagery and later validated with field inspections. LCUs are a way to summarise differences in landscape amenity and the sensitivity of different areas within the landscape to visual impacts;
- Define areas in which the infrastructure may be visible, using ZVI modelling. A map identifying the ZVI (viewshed) of the proposed solar farm was produced. This method uses topographic information to determine areas in which views of infrastructure may be visible. The infrastructure was modelled as a 4.5m high, equivalent to the project boundaries. Topography was based on a fine resolution Digital Elevation Model (DEM) derived from 25m contours. Modelling does not consider screening that may be provided by existing vegetation or structures, mapping is included in Appendix B.
- Identify key viewpoints such as major travel routes, public recreation areas, potential receivers (dwellings and other structures), and built up areas. This step excluded areas deemed not to be visible from the ZVI modelling;
- Understand the feasibility of screening to mitigate visual impact.

The ZVIs of the fore (200m) and mid ground (1km) are provided in Appendices B, and C respectively. The results of this modelling were used to inform the field survey.

2.3. FIELD SURVEY

With reference to the mapping and modelling, field reconnaissance and ground truthing was undertaken to:

- Verify and document the existing LCUs in the study area;
- Identify representative viewpoints within the LCUs, including foreground, middle ground and background viewpoints;
- Understand the likely sensitivity of the LCUs to views of the proposed solar farm.

Fieldwork consisted of driving along publicly accessible roads, investigating and documenting dominant visual character elements and potential views to the proposed infrastructure. Photographs were taken at representative locations. No residences were specifically targeted however, nearby roadside and common land viewpoints have been tagged 'residential' where they occur near a residence.

Representative view point locations and their associated LCUs are provided in Table 2. Representative panoramas for selected locations are provided in Table 6. The property involved in the leasing of land for this project is not represented by a specific viewpoint. Impacts on this property have not been considered.

2.4. IMPACT ASSESSMENT

The impact assessment methodology used in this Visual Impact Assessment is based on the Bureau of Land Management (BLM) Visual Resource Management System, developed by the BLM, US Department of the Interior (n.d), the Guidance Note for Landscape and Visual Assessment, Australian Institute of Landscape Architects and the Guideline for Landscape character and visual impact assessment (TfNSW). The BLM developed a systematic process to analyse the visual impact of proposed developments. The basic philosophy states that the degree to which a development affects the visual landscape depends on the visual contrast imposed by the project.

Key steps undertaken to assess the visual impact are as follows;

- Identify the extent of visibility of the proposal by;
 - The scenic quality of the study area's LCUs.
 - The expected sensitivity at representative viewpoints.
 - The proximity of each representative viewpoint.
- Identify existing viewpoints and their sensitivity to change;
- Determine the magnitude of change for each viewpoint;
- Assess visual impact

Criteria for scenic quality, sensitivity, proximity, magnitude, and visual impact are included in the assessment, in Section 5.

Mitigation measures are considered for 'high impact' receivers, for whom unmitigated impacts are considered greater than what is acceptable. For 'medium impact' receivers, the contrast is

considered acceptable. For 'low impact' receivers, the contrast is considered unlikely to be perceived or acceptable.

3. EXISTING ENVIRONMENT

3.1. WERRIS CREEK LOCALITY

The proposed project is located in Werris Creek, on the eastern side of Black Gully Road and Russell Street, within the Liverpool Plains Shire Council Local Government Area (LGA) (refer to Appendix A). The land on which the proposal is situated is generally referred to as 962 Black Gully Road, Werris Creek NSW 2341, Lots 229 and 230, DP 751034; Lot 1 DP 255599; Lot 3 DP343532 and Lot 1 DP509915. The proposed development is restricted to a portion of Lot 1 DP509915 as indicated in Appendix A.

The site consists of a large rural type lot which is predominantly used for primary production and comprises scattered trees, low grassland, drainage lines and associated dams. A number of unnamed but mapped watercourses are present on the site draining to Werris Creek which forms the northern boundary of the development lot.

West of the site is the main township of Werris Creek and is represented largely by residential dwellings and the Werris Creek Community Hospital. Approximately 440m to the north of the site is the Werris Creek Waste Management Facility. To the south and east of the site are large scale rural primary production properties. The nearest dwelling is located approximately 90m to the west from the boundary of the development lot.

3.2. SIGNIFICANT VISTAS AND FEATURES

3.2.1. Viewing locations

Residential properties located approximately to the west of Black Gully Road and approximately 500m to the west of the proposed development, are situated along a ridge line with views out over the agricultural valley towards the Liverpool Ranges (Photo 1).

The properties along the ridge line have uninterrupted views and several have been named after the view, with names such as 'Valley View' and 'Top View'.

Given the elevation of the residential properties the solar farm will be highly visible from the properties and from the existing public road (Black Gully Road). Viewing locations were assessed during the desktop study and confirmed for representativeness during the field study. Six locations were chosen based on the highest probability of contrasting views and included in the Viewshed modelling (Appendix B), to indicate the extent to which the proposed solar farm infrastructure would be visible. These locations were;

Table 2: Viewing locations included in Viewshed modelling

ID	LCU	View location
M1	Rural residential	Anzac Parade
M2	Rural residential	Black Gully Road
M3	commercial	Werris Creek Hospital
M4	commercial	Electrical substation
M5	Road	Black Gully Road
M6	Agricultural	Glen Alpine Road

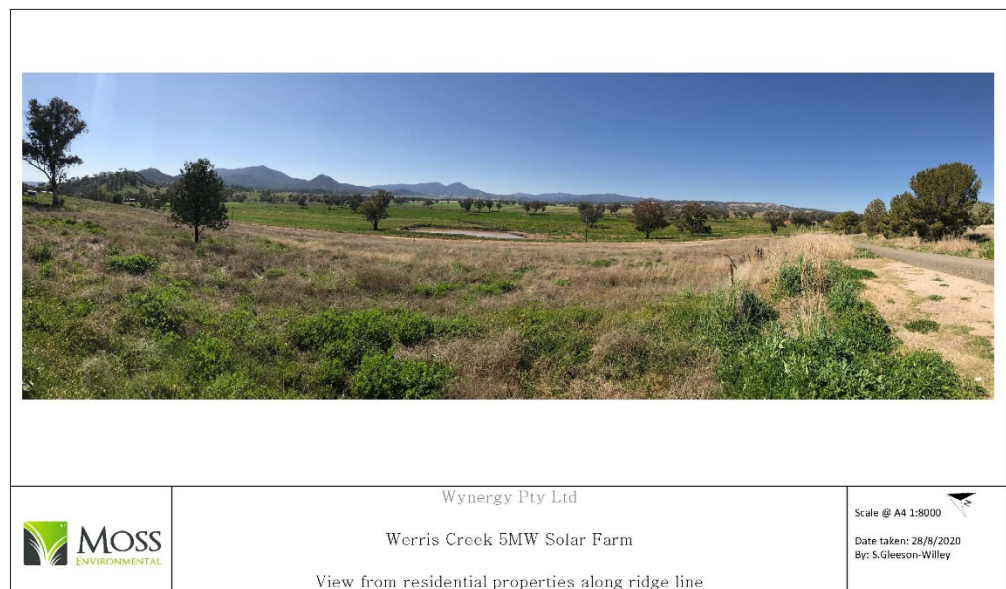


Photo 1: View of valley and ranges from Anzac Parade

3.2.2. Dark sky region

Siding springs Observatory is located approximately 150km north west of the proposed Menz solar

farm. The Dark Sky Region in NSW is centered upon the site of this observatory which is considered Australia's most important visible-light observatory. The Dark Sky region consists of land within a 200km radius of the observatory, which therefore includes the solar farm proposal site.

The Dark Sky Region Guidelines have been prepared to ensure the night sky is free of light pollution and increased levels of atmospheric dust which may impact on the observatory¹. These guidelines are referenced in the *Dark Sky Planning Guideline – Protecting the observing conditions at Siding Spring (DoP 2016)*.

General measures to minimize light pollution include control of upward spill night lighting (such as the use of shields), reducing the overall number of lights and the duration that they are used for, using asymmetric beams when using floodlights, ensuring lights are not directed towards reflective surfaces and using warm white colours.

Relevant environmental considerations for the solar farm, given its location within the Dark Sky Region include:

- Construction phase
 - Control of dust from vehicle haulage, excavation, any clearing required, stockpiles. Water or other means can be used to control dust.
- Operational phase
 - Control of dust from the operation; maintenance of ground cover beneath panels, minimizing traffic movements on unsealed tracks during operation.
 - Night lighting limited and if required, undertaken with the above prescriptions to minimize its impact.

These measures have been incorporated into environmental mitigation measures for the proposal, Section 7 of this report.

¹ Dust tends to scatter light and increase light pollution.

3.3. COMMUNITY VALUES

3.3.1. General attitudes to solar infrastructure

According to the research report *Community Attitudes to Renewable Energy in NSW* undertaken by the Office of Environment and Heritage (2015), 92% of people in North West NSW support solar farms in their local region with 84% supporting a solar farm within 1-2 kilometers of where they live. Amongst the 34% who opposed a wind farm within 1-2 kilometers of where they lived, the unprompted concerns most commonly raised were noise (69%), location suitability (30%), visual impact (28%) and health issues (23%).

Whilst most members of the community are aware of small- or large-scale solar energy, many do not know a great deal about their impacts (ARENA, 2015), including visual impacts.

Three approaches to improving community understanding of the visual impacts of large-scale installations include:

- Provision of images (from many angles) of small-scale solar facilities, particularly in the early stages of a proposal;
- Understanding the similarities between highly supported domestic scale installations and small-scale facilities;
- Understanding the current function of the land proposed to hold the facility and the additional value the installation allows for.

During the site survey conducted by Moss Environmental, several interested community members with residences located along the ridge, west of the proposed site approached our staff with concerns about the development impacting on the vista from their homes, and resulting in a decrease in value. One community member pointed out that several of the houses located along the ridge line have been named after the view, indicating that the owners value the view.

3.4. LANDSCAPE CHARACTER UNITS

LCUs take into account topography, vegetation, land use, and other distinct landscape features. They are a way to summarise differences in the receiving environment that may affect the visual impact of the proposed solar farm at different locations.

Four key LUCs were identified within 15km of the proposed solar farm site:

- Agricultural (grazing lands and cropping lands, with low density dwellings and sheds).
- Rural residential facilities.
- Urban (Werris Creek town centre and residential areas).
- Bush (surrounding ranges)

The scenic quality was rated in each LCU as follows;

- A high scenic quality rating describes areas with outstanding, unusual or diverse features;
- A moderate scenic quality rating applies to areas with the features and variety normally present in the character type.
- A low scenic quality rating is given for areas lacking features and variety.

Scenic quality is a measure of the visual appeal of a tract of land. In the visual resource inventory process, public lands are given an A, B or C rating based on the apparent scenic quality which is determined using seven key factors: landform, vegetation, water, colour, adjacent scenery, scarcity and cultural modifications.

The four LCUs identified within 15km of the proposed solar farm site are characterized in Table XX in terms of their scenic quality illustrated in the following plates.

Table 3: Landscape Character Units Identification

Landscape Character Unit	Key visual features and scenic quality
Agricultural	Visual features The pastures with scattered trees are of low relief to undulating. Pastures are generally not irrigated and so are green through to beige and brown with the season. Some cropping occurs within the locality. Scattered trees are either at low density, remnants of an open woodland, or planted along roadways, or dwellings. Cropped paddocks and more intensively cleared area have less variety. The ranges to the east and south east of the site are a dominant feature from most locations, contrasting with low open expanses of the lower landscape. The colour would change from dusky green blue to purple and brown hues with season and time of day. Unsealed roads are light beige. Local roads are a combination of sealed and unsealed. Local roads are generally straight within minor curves that reflect the gently undulating terrain. Werris creek is located along the flats and up a slight rise to a ridge that provides views from an elevated position for approximately 8.3km across the valley floor to the ranges. Residences within this landscape are moderately densely distributed and mainly concentrated along the top of the ridge line and on the slope on the western side of the ridge. Other residences within the landscape are sparsely distributed and commonly associated with additional landscape plantings and outbuildings (sheds). Low paddock fencing, electricity lines and roads reinforce a linear pattern of production over the more organic pattern of the terrain. The Werris Creek hospital is located along the ridge to a slightly northern position compared with the proposed development site. The hospital has a

	respite garden located on the eastern side of the building which has views over the proposed development site towards the ranges. The building otherwise is of low profile with viewpoints from hospital rooms concentrated mainly to the north and north east. Scenic quality – Elements have moderate variety and contrast and feature naturally pleasing elements such as the ranges and scattered native vegetation remnants. Built elements are production related. Grazing and cropping areas are considered to have moderate scenic quality due to the contrast with the ranges and colour variety. This LCU is distinctive, though somewhat similar to others within the region, and received an SQI rating of High (B-13) (evaluation chart, Visual resource inventory, BLM 1986). The proposed solar farm is located within this LCU.
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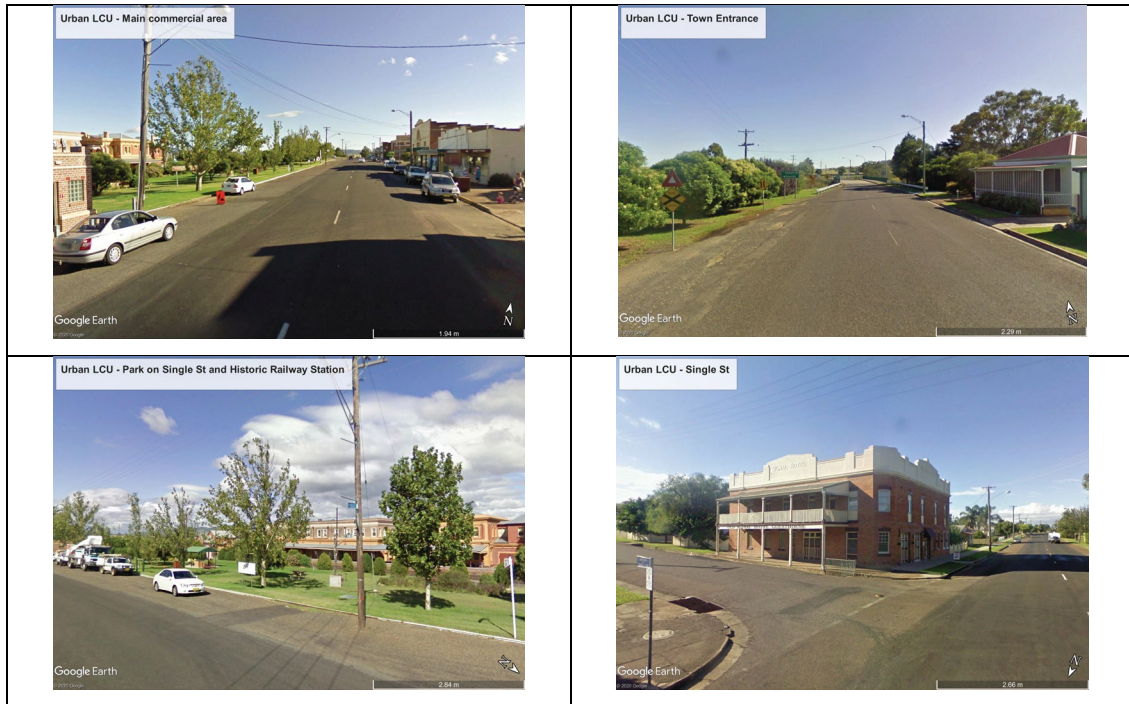
Landscape Character Unit	Key visual features and scenic quality
Rural / Residential and commercial	Visual features Smaller residential allotments occur to the west of the site, off Back Gully Road. A hospital, public swimming pool and power substation occur to the west of the site located along the ridge top. The Werris Creek waste management facility occurs to the north west of the site. In these areas, which are surrounded by agricultural LCU in most cases, dominant elements are dwellings, gardens, car ports and in the case of commercial facilities, large structures and access roads (often tree lined).

	Built forms are varied. Roofs, cladding, brick, water tanks and sheds are not consistent. Vehicles, gardens and yards produce a residential character. These areas are separated from the surrounding expansive agricultural areas with a parcel of vacant land (common) and occasionally rectilinear fencing, creating small boxed allotments within the broader landscape. Electrical infrastructure includes overhead transmission lines and a substation. Streets and access roads are sealed and feature vegetation, either native remnants or planted features trees or avenues. Scenic quality - Scenic quality is considered low (10-C) in residential locations. These areas have variety in colour and form, including some historic features. Built elements and landscaping contribute to the character type. Scenic quality is considered low in commercial areas, these being commercially focused and having similar variety and visual interest. This LCU is common in the study area.
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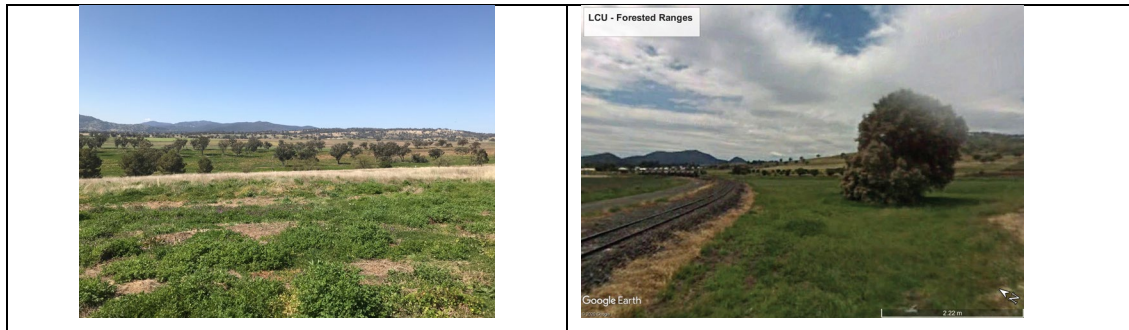
Landscape Character Unit	Key visual features and scenic quality
Urban	Visual features Werris Creek is situated within a mainly agricultural landscape to the west of the Liverpool Ranges. The town is built on the historic railway line and has a small size open cut coal mine to the north west. The railway line runs parallel to the main street with recreational spaces separating the railway buildings and road. The light greens of the shady recreational and public spaces provide the town with a unique character and public amenity. Werris Creeks main street has a consistent historic character. In retail and residential building colours, materials and design, historic character, red brick and weatherboard elements are dominant. There are a few large public and private buildings with exceptional character. There are railway elements and displays that reinforce the character of the area. Frontages feature street trees and decorative facades. There are no views to the proposed development site. Streets are sealed and often incorporate curbing and footpaths and landscaping. The street layout is generally rectangular. Scenic quality – Scenic quality is considered moderate (12-B). These areas have variety in colour and form. They contribute to the unique historic character type, in residential and commercial built form. Elements include recreational facilities, parks and gardens, historic buildings and displays. The character is important in defining the history and land use in the local area. This LCU is not common in the study area.





Landscape Character Unit	Key visual features and scenic quality
Forested Ranges and Bushland	Visual features The vegetated ranges to the east of Werris Creek, provide a dominant visual element to the upper reaches of the town and surrounding areas. No known lookouts and walking tracks are present, that would allow views of the town from the east, towards the proposed solar farm. Limited public roads traverse the Ranges. Vegetated ranges also occur to the west, near the New England Highway. The unique character of these ranges and the dark green vegetation add to the unique character provided by dense, mature vegetation. Scenic quality – Scenic quality is generally High (A-23). Colour variation is moderate, landform is generally uniform, lacking stark variety. However, the landform is characterized by high vertical relief in contrast to the agricultural low lands, dominating the scene and greatly enhancing the visual quality. The colour, whilst uniform changes with the time of day and season

	providing variety. This LCU is common in the study area.
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3.5. VIEWPOINT SENSITIVITY

3.5.1. Identifying viewpoints

The BLM methodology requires identification of representative viewpoints in the study area. These may be travel routes such as roads, waterways and recreational tracks, residential areas, tourist facilities, houses and farmland.

The ZVI modelling produced a set of maps that estimated the areas that would be shielded from views of infrastructure at the proposed solar farm site, based on topography. A height of 4.5m was used to model onsite infrastructure. This realistic approximation of the height of panels and PV containers, as the panel heights may be up to 4.5m. Viewpoints were not selected in areas predicted to be shielded from views of the solar farm. Five representative viewpoints were identified within the ZVI and are mapped in Appendix B.

3.5.2. Rating proximity and assessing sensitivity of viewpoints

The predicted sensitivity of each viewpoint can be determined, considering its proximity to the proposed solar farm site and factors such as use, scenic quality and regional significance.

Criteria for proximity are as follows:

- Foreground 0-1 kilometer
- Middle ground 1-5 kilometers
- Background 5-15 kilometers

Criteria for sensitivity are as follows:

- High sensitivity:
 - High use routes or areas, or
 - Routes or areas of national or state significance, or
 - Areas with high scenic quality.
- Moderate sensitivity:
 - Moderate use routes or areas, or

- Routes or areas of regional or local significance, or
- Areas with moderate scenic quality
- Low sensitivity:
 - Low use routes or areas, or
 - Routes or areas of low local significance, or
 - Areas with low scenic quality

Sensitivity also considers view duration; for access roads and working farms this would be less than for residential and recreational areas.

Considering the sensitivity of local viewpoints, the following general assessments were made;

- Within the Agricultural LCU, viewpoints were assessed to be of low sensitivity on low use roads and moderate sensitivity on higher use roads that retain some remnant vegetation. These areas are production related but offer vistas of farming land and highly vegetation ranges broken up by native vegetation. Black Gully Road and Glen Alpine Road are unsealed roads used to access the waste management facility an electrical substation.
- Within the Rural residential / commercial LCU, viewpoints were assessed as high sensitivity (the electrical substation on Black Gully Road, the Werris Creek hospital on North Street and the public pool on Punyarra Street, noting that the views to the ranges and of farming land broken up by native vegetation are assumed to be valued).
- Within the Urban LCU, viewpoints were assessed to have low sensitivity, with limited views, low usage of open spaces and no recreational facilities.
- Within the Forested Ranges and Bushland LCU, there were no viewpoints assessed as there are no public lookouts, roads or walking tracks with views towards Werris Creek.

The sensitivity of each viewpoint is tabulated below. The location of each viewpoint is shown in Appendix B.

Table 4: Viewpoint Sensitivity Identification

ID	LCU	View location	Proximity	Scenic quality	Sensitivity
M1	Rural residential	Anzac Parade	<1km	Moderate	High
M2	Rural residential	Black Gully Road	<1km	High	High
M3	commercial	Werris Creek Hospital	<1km	Moderate	Moderate
M4	commercial	Electrical substation	<1km	High	Low
M5	Road	Black Gully Road	<1km	High	Low
M6	Agricultural	Glen Alpine Road	<1km	Moderate	Low

4. VISUAL CHARACTERISTICS OF KEY INFRASTRUCTURE COMPONENTS

The proposed Menz SF would comprise of the installation of a solar plant with an upper capacity of 5MW that would supply electricity to the national electricity grid. An indicative proposed infrastructure layout is included in Appendix C. Visual characteristics of the development would differ in the construction and operational phases of the development. Decommissioning would be similar but likely of shorter duration than construction.

4.1. CONSTRUCTION AND DECOMMISSIONING

Construction and decommissioning visual impacts during each phase would include;

- Material laydown areas, site fencing and signage, traffic controls, additional haulage on local roads, associated dust rising from onsite and offsite vehicle movements.
- Temporary construction site offices; and
- Temporary car parking areas for construction worker's onsite.

Fencing and buildings would include steel structures. These can generate reflectivity and glare which is discussed in greater detail in the Reflectivity study. Material stockpiles may detract from visual amenity, particularly if dispersed across broad areas. Laydown areas for steel posts and rails may produce reflectivity and glare which is discussed in the reflectivity report.

Construction litter (such as packaging materials and food/drink packaging from onsite staff), if not controlled, could affect nearby properties.

Construction traffic would increase visual impacts and could add to dust generation on local roads and once on-site. Onsite parking areas would be visible from surrounding properties and roads, most visible from Black Gully Road and Glen Alpine Road.

While no broad scale land levelling is proposed, it is expected that the combined effect of the onsite construction activities will have an adverse impact on the amount of ground cover, producing dust and detracting from the visual amenity of the site. Dust is manageable and maintaining ground cover beneath the panels once construction is completed is an objective of the proposal; any areas would be restored to grassed ground cover post construction.

4.2. OPERATION

Operational visual impacts would relate to the permanent infrastructure. It is generally low lying (less than 4.5m) and therefore visibility attenuates rapidly with distance from viewpoints of similar elevation. However, there are several close by LCUs that are elevated compared with the proposed solar farm.

Minor traffic movements relate to operation. Key permanent infrastructure that would be visible during the 30-year life of the project would include;

- PV modules (solar panels), single axis horizontal tracking frames.

- The solar arrays would be comprised of approximately 13,000 monocrystalline panels that will be attached to 216 x 2P Single Axis Trackers aligned north-south over approximately 8ha of paddock. The tracker would have an estimated tracking range of 120 degrees, or +/- 60 degrees from the horizontal;
- Approximately 1000 piles would be driven or screwed into the ground to support the solar array's mounting system and solar modules; and
- The panel structures would have a height of approximately 4.1m high when tracked to the extent of their range and allowing for undulating topography.



Photo 2: Example of solar farm panels

- Inverter stations with associated transformers. The 27 x 185kw small string inverters will be installed on piles and dispersed through the array and are slightly elevated above the ground to enable the installation of the AC and DC cabling, The site will contain the following equipment:
 - 27 x small Inverters
 - 1 x 5MVA transformer located in a shipping container
 - Energy management zone with 1 x energy management / control room in a shipping container with communications and ancillary equipment



Photo 3: Example 20' skid solution

- A 11kV underground transmission line (approx. 800m) and aerial cable from the existing power pole to the T connection with the 11kV feeder (approx. 50m) to the adjacent

Werris Creek substation.

- The transmission line would be constructed over a length of approximately 800m from the site energy connection zone, follow the proposed access road and cross over Black Gully Creek aerially before connecting to the existing Werris Creek Substation.
- Underground electrical conduits and cabling to connect the inverters to the Werris Creek substation.
 - All underground cabling would be installed across the site at a depth of at least 500mm with the electrical reticulation buried to either 600mm (low voltage) or 800mm (high voltage) depth, depending on the cables voltage and relevant Australian Standard.
 - Prior to excavating the cable trench, the topsoil would be stripped and stockpiled for use in the rehabilitation of the trench following the cable installation.



Photo 4: Example of underground cable trench with bedding sand installed.

- Access Tracks
 - The entrance to the site would be constructed off Black Gully Road, approximately 730m from the intersection with Anzac Parade. No additional road works are proposed.
 - The internal solar farm access road would be approximately 3 meters wide with a 5m wide turning circle, unsealed with gabion/ballast rock subgrade and grey road base overlay material to reduce visual impact and manage onsite drainage.
 - If required, water carts will be used to suppress dust on unsealed access tracks during construction.
- Perimeter security fencing up to 2m high.
 - Fencing is expected to be reinforced rural mesh with 1 or 2 barbed wire located within the top 450mm. The fence would be designed to ensure adequate access and egress points are provided during both the construction phase and ongoing operational life of the project.
 - The majority of the fenced perimeter would be targeted for landscaping treatment as per the landscaping plan.
- Native vegetation screening, where required to break up views of infrastructure to specific receivers.

- Specific sections of the site perimeter have been identified in Appendix C.

4.2.1. Glare and glint

The potential for glare associated with non-concentrating photovoltaic systems which do not involve mirrors or lenses is relatively limited. PV solar panels are designed to reflect as little sunlight as possible (generally around 2% of the light received (US Department of Energy Solar PV and Glare Fact Sheet), resulting in negligible glare. The reason for this is that PV panels are designed to absorb as much solar energy as possible in order to generate the maximum amount of electricity or heat. The panels will not generally create noticeable glare compared with an existing roof or building surface (NSW Department of Planning 2010), and is similar to smooth water (US Dep of Energy 2018). Seen from above (such as from aircraft) they appear dark grey and do not cause a glare or reflectivity hazard. Solar photovoltaic farms have been installed on a number of airports around the world.

Other onsite infrastructure that may cause glare or reflections depending on the sun angle, include:

- Steel array mounting – array mounting would be steel or aluminum.
- Temporary construction site offices.
- Inverter stations
- Transmission line power poles.

These are discussed further in the Reflectivity Study (Wynergy, 2020).

5. IMPACT ASSESSMENT

The visual impact assessment was undertaken considering;

- The infrastructure components, described in Section 4;
- Their potential to be viewed from representative viewpoints; and
- The degree of contrast they would have within identified LMZs.

LMZs were assigned to each viewpoint and the contrast at that viewpoint was evaluated, as described below.

5.1. DEFINITION OF LANDSCAPE MANAGEMENT ZONES

Visual LMZs were assigned to each viewpoint. The zones were derived by combining scenic quality (from the LCU, Section 3.2), viewer sensitivity and the distance to the proposed solar farm site (from Section 3.3). Combined they produce a three-tiered management hierarchy: A-C, as shown in Table 5.

Table 5: Visual Landscape Management Zone decision matrix

Proximity / sensitivity								
Scenic quality		Fireground High	Middle ground High	Background High	Foreground Moderate	Middle ground Moderate	Background Moderate	Fireground Low
High		A	A	A	A	B	B	B
Moderate		A	B	B	B	B	C	C
Low		B	B	B	B	C	C	C

Each zone has associated objectives to guide management of visual change and to help evaluate proposed project impacts. These are shown in Table 6.

Table 6: Management of Project Impacts

Management priority	Management objectives
A	Maximise retention of existing visual amenity. Landscapes are least able to absorb change. Developments may lead to a major change.
B	Maintain existing visual amenity, where possible. Protect dominant visual features. Developments may be allowed to be visually apparent.
C	Less importance for retaining existing visual amenity. Landscapes can absorb change. Developments may be allowed to dominate but should reflect existing forms and colours where possible.

5.2. VISUAL IMPACT ASSESSMENT AT REPRESENTATIVE VIEWPOINTS

5.2.1. Evaluation Criteria

The ratings for the degree of contrast created by the proposed solar farm infrastructure for each viewpoint have the following definitions.

- High contrast: the proposed solar farm would be dominant within the landscape and generally not overlooked by the observer, the visual change would not be absorbed.
- Medium contrast: the proposed solar farm would be moderately dominant and noticed, the visual change would be partially absorbed.
- Low contrast: the proposed solar farm would be seen but would not attract attention, the visual change would be well absorbed.
- Indistinct: contrast would not be seen or would not attract attention; the visual change would be imperceptible.

For the proposed solar farm, this rating is given considering the generally low height of infrastructure, and its likely visible horizontal extent from the viewpoints. This also considers topography and intervening vegetation that may affect the proposed solar farm's visibility from the viewpoints.

To determine whether the objectives of the visual LMZs zone are met, the contrast rating for the viewpoint is compared with the relevant management objectives to give a visual impact level.

Magnitude refers to the form – scale, size, character of the project and its proximity to the viewer.

The consideration of overshadowing during the day and lighting at night may also be a consideration of magnitude. Magnitude assessment is based on the amount of change which can be inferred within a particular viewpoint. The visual impact level (magnitude) is consequently defined as:

- High impact: contrast is greater than what is acceptable.
- Medium impact: contrast is acceptable.
- Low impact: visual contrast is little or not perceived and is acceptable.
- Indistinct impact: Visual change imperceptible

For high impact viewpoints, mitigation must be considered. The impact assessment process is represented in Figure 1.

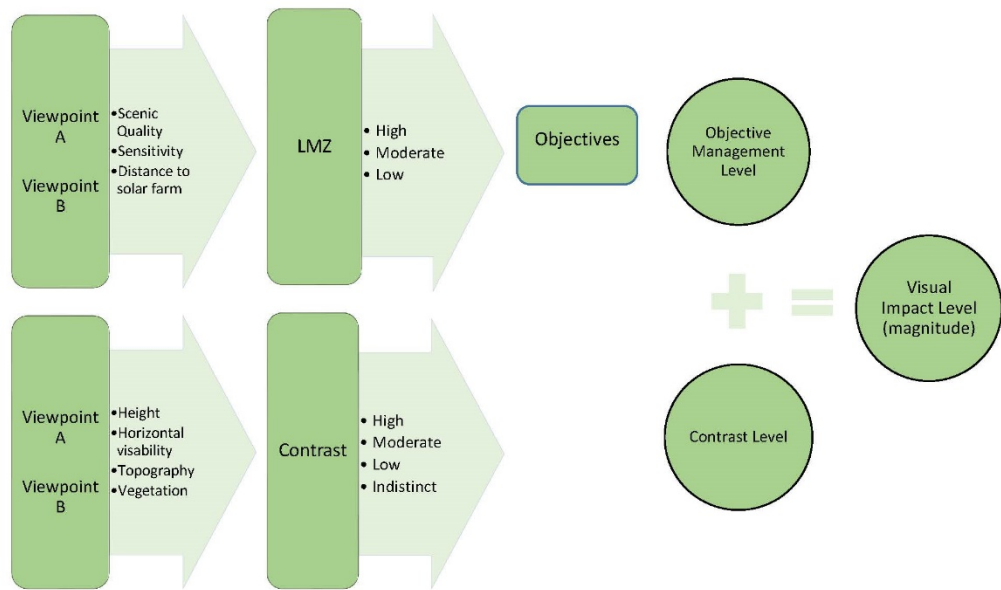


Figure 1: Visual Amenity Assessment Process

The assessment of visual sensitivity and magnitude and the combined visual impact is set out in the schedule below with descriptions and photographs justifying all analysis and conclusions.

Viewpoints assessed as being of Indistinct have not been included in the schedule.

Table 7: Summary of Assessment

View	Location and viewpoint	Proximity	LCU	Element of project visible	Scenic quality	Sensitivity	Contrast	LMZ objective		Visual impact	Summary
M1	Anzac Parade / Road	<1km	Rural / residential	Solar PV array panels, access road	Mod	High	Med	B	Maintain existing visual amenity, where possible	Med	The array infrastructure would be located in parallel to Black Gully Road, approximately 300m from the road. While a vegetation screen is proposed along the western site boundary, this will take several years to mature to full height. Given the elevated location of residential properties, there would be some visual impact until vegetation reaches maturity. Whilst there is some existing infrastructure in the area (transmission lines, substation), the solar infrastructure would be a new type of structure and contrast with the existing agricultural landscape character while adding some cumulative industrial visual impacts to the locality. Mitigation is recommended Advanced trees (saplings) and shrubs should be used in the vegetation planting on the site's boundary parallel to Black Gully Road to obscure /break-up views of the infrastructure for elevated residences.



Panorama from view point M1, the black line marks the horizontal extent of stage 1 and the blue line 2, array infrastructure potentially visible from this location.

M2	Elevated residential properties	<1km	Rural /residential	Full Site	High	High	High	A	Maximise retention of existing visual amenity	High	The location further south east along Black Gully Road would view array infrastructure for an unbroken stretch of approximately 813m. Little overstorey vegetation is present on the western solar farm boundary. As above, the solar infrastructure would be a new type of structure and contrast with the existing agricultural landscape character while adding some cumulative industrial visual impacts to the locality. Mitigation is recommended Mitigate impacts through good design and use fast growing endemic species in the vegetative screening. Carry out additional consultation with affected residents at these locations, to inform the need for offsite
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											mitigation.
  Panorama from view point M2, green dot is the photo location, the blue dot is a similar view point. The black line marks the horizontal extent of stage 1 and the blue line 2, array infrastructure potentially visible from this location.											
M3	Werris Creek Hospital	<1km	Commercial	Small section of Stage 2 PV array	Mod	Mod	Mod	B	Maintain existing visual amenity, where possible	Low	Located adjacent to the northern extent of the proposed infrastructure, on the top to back-side of the ridge, the low-lying solar infrastructure is not expected to represent a high contrast in this undulating agricultural landscape. Existing vegetation particularly along Black Creek Road and the existing black hospital fence is expected to soften the views of the infrastructure further. Mitigation recommended Proposed vegetation screening is recommended.

											
M4	Electrical substation	<1km	Infrastructure	Stage 1 of PV array and associated infrastructure	High	Low	Low	B	Maintain existing visual amenity, where possible.	Medium	Views from the electrical substation are over the proposed solar farm towards the ranges. The views are impressive and valued by local traffic. The solar farm proposal site is located to the north-east, behind the existing transmission line. Views of the proposed infrastructure will be unimpeded, however sensitivity is considered low since the views are from a small electrical substation and unsealed no through road used mainly for local traffic No mitigation recommended.
											
M5	Black Gully Road	<1km	infrastructure	Full proposed project	High	Low	Low	B	Maintain existing visual amenity, where possible.	Low	Views from Black Gully Road are across an agricultural landscape towards the ranges. The proposed solar farm would be located parallel to the road to the east, over a rise. There are limited views within the

									possible.		viewshed due to the low lying road and relatively low infrastructure proposed. No mitigation required.
											
M6	Glen Alpine Road	<1km	Road and commercial	Stage 2 PV arrays	Mod	Low	Low	C	Less importance for retaining existing visual amenity.	Low	Views from Glen Alpine Road are across agricultural landscape towards the proposed solar farm in the south. Glen Alpine road is low lying with the solar farm located over a rise. There are limited views within the viewshed due to the relatively low-lying infrastructure, remnant vegetation and distance of 400m. No mitigation required



6. Results Summary and Recommendations

6.1. Representative viewpoints

6.1.1. High Visual Impact

In high visual impact locations, mitigation is required. One high impact view location was identified for the project. The LCU was rural / residential properties located on highly elevated locations off Black Gully Road. For these locations, additional consultation and offsite vegetative screening is proposed.

6.1.2. Medium Visual Impact

In medium visual impact locations, mitigation has been recommended to further soften views of infrastructure, either on the solar farm site or at specific offsite locations. Medium impact was identified for two locations. Of these, mitigation is recommended at both locations. The resulting recommendations are that:

6.1.2.1. A medium density vegetation screen be included along the full proposed solar farm boundary with specific sections targeted for advance trees / tall growing endemic shrubs, to mitigate cumulative impacts and lessen the contrast of the infrastructure given the close proximity of the solar array infrastructure to residential properties, and the elevated positions of these properties.

6.1.2.2. Additionally, two areas where small groves could be established have been identified. These will provide a more natural structure to the vegetation; akin to small remnants. Refer to Appendix X for the proposed locations of the screen. The screen would be of varying native species and of varying height to soften not block the view of the site. Breaks in the screen, reflecting natural breaks in existing remnants would be appropriate. A hedge or formal row of trees is not recommended.

6.1.3. Low Visual Impact

The remaining three viewpoints were assessed to have a low visual impact. No mitigation is considered for these locations.

In summary, the visual contrast produced by the development would be high to medium for residential properties located off Anzac Parade and Punyarra Street, whilst the sensitivity was considered medium to high. Perimeter plantings could assist to break up the views of the infrastructure and would also address cumulative impacts of this infrastructure to maintain the landscape character.

In most locations, the roadside representative viewpoints were considered sufficient to assess and consider mitigation for the residences in these locations. However, two residential properties located off Black Gully Road, built on elevated locations could not be adequately investigated due

to no prior community consultation. These residences have been recommended for additional mitigation, to be determined during consultation and included in the Mitigation Strategy, prepared prior to construction commencement.

6.2. Dark Sky region mitigation

Additional impacts are relevant to the proposal, given its location within the Dark Sky Region. Construction activities have the potential to increase the level of dust in the immediate locality temporarily. As discussed in Section 4, excavation would be minimal however the increase in traffic on unsealed internal access tracks and Black Gully Road is likely to increase local dust levels, particularly in dry conditions. Dust would be suppressed during construction through the use of water applications and covering of loads. No night lighting, with the exception of limited security lighting is anticipated.

During operation, the dust generation would likely be less than for existing agricultural land use. The arrays themselves as well as the ground cover retained beneath the array will limit dust generation and movement.

7. MITIGATION STRATEGY

The following measures are recommended to address the visual impacts of the proposal.

7.1. VEGETATION SCREENING

Solar farm vegetation screening:

- A medium density screen, 1-2 rows deep, would be established with reference to the Landscaping Plan (Wynergy 2020).
- The screen would be comprised of varying native species appropriate to the area and of varying heights to soften not block the view of the site.
- Breaks in the screen, reflecting natural breaks in existing remnants would be appropriate;
- Planting should be undertaken as soon as practical in the construction process depending on the season, as it will take time for the plants to establish and become effective as a screen. Seasonal requirements for planting should also be considered;
- The screen would be maintained for the operational life of the solar farm. Dead plants would be replaced. Pruning and weeding would be undertaken as required to maintain the screen's visual amenity and effectiveness in breaking up views.
- Advanced (sapling) plants of native trees to be placed in locations appropriate to screen residential properties of the solar farm.

7.2. General Measures

7.2.1. Design

- Where feasible, underground rather than overhead power lines would be considered.
- Where feasible, co-location of powerlines would be undertaken to minimize the look of additional power poles. If additional poles are required, these would match existing pole design as much as possible.
- The materials and colour of onsite infrastructure will, where practical, be non-reflective and in keeping with the materials and colouring of existing infrastructure or of a colour that will blend with the landscape. Where practical:
 - Proposed new buildings will be non-reflective and in eucalypt green, beige or muted wheat.
 - Pole mounts will be non-reflective.
 - Security fencing posts and wire would be non-reflective; would maintain the rural infrastructure look.

7.2.2. Construction

- During construction, dust would be controlled in response to visual cues;
- Areas of soil disturbance by the project would be rehabilitated progressively or immediately post-construction, reducing views of bare soil.

7.2.3. Operation

- Maintenance of ground cover beneath panels, to reduce dust.
- Minimise traffic movements on unsealed tracks, to reduce dust; and
- Nigh lighting is not proposed at this stage.

8. CONCLUSION

This visual Impact Assessment includes a full assessment of the visual impacts associated with the proposed Menz Solar Farm.

After mitigation measures are applied no high visual impacts would result from the project. The western site boundary of the proposed solar farm is to be targeted for additional vegetation screening to mitigate cumulative impacts and lessen the contrast of the infrastructure given the proximity and elevated position of residential properties. Refer to the Landscaping Plan (Wynergy 2020) for planting locations. The proposed planting, which includes sections of perimeter planting as well as groves, could assist to break up the views of the infrastructure and would also address cumulative impacts of this infrastructure to maintain the landscape character and avoid a more industrial character becoming dominant.

A set of general mitigation measures, including the design, construction and operational phases of the project are included primarily to lessen the contrast of new structures and manage dust and light spill of the project. The measures are aimed at retaining the visual values the community

values; existing views of the agricultural land, hills and greenery.

9. REFERENCES

- ARENA, 2015, *Establishing the social licence to operate large scale solar facilities in Australia: Insights from social research for industry*, Australian Renewable Energy Agency (ARENA).
- Australian Institute of Landscape Architects, *Guidance Note for Landscape and Visual Assessment*, June 2018.
- Bureau of Land Management, n.d, *Bureau of Land Management Visual Resource Inventory*, access 2 September 2020, <https://blmwyomingvisual.anl.gov/vr-inventory/blm/>
- Transport for NSW, *Guideline for Landscape Character and Visual Impact Assessment*, 2020.
- Wynergy, *Landscaping Report – Menz Solar Farm*, 2020
- Wynergy, *Reflectivity Report – Menz Solar Farm*, 2020

10. APPENDIX

A. Locality Plan



Wynergy Pty Ltd

Werris Creek Menz 5MW Solar Farm,
Stage 1

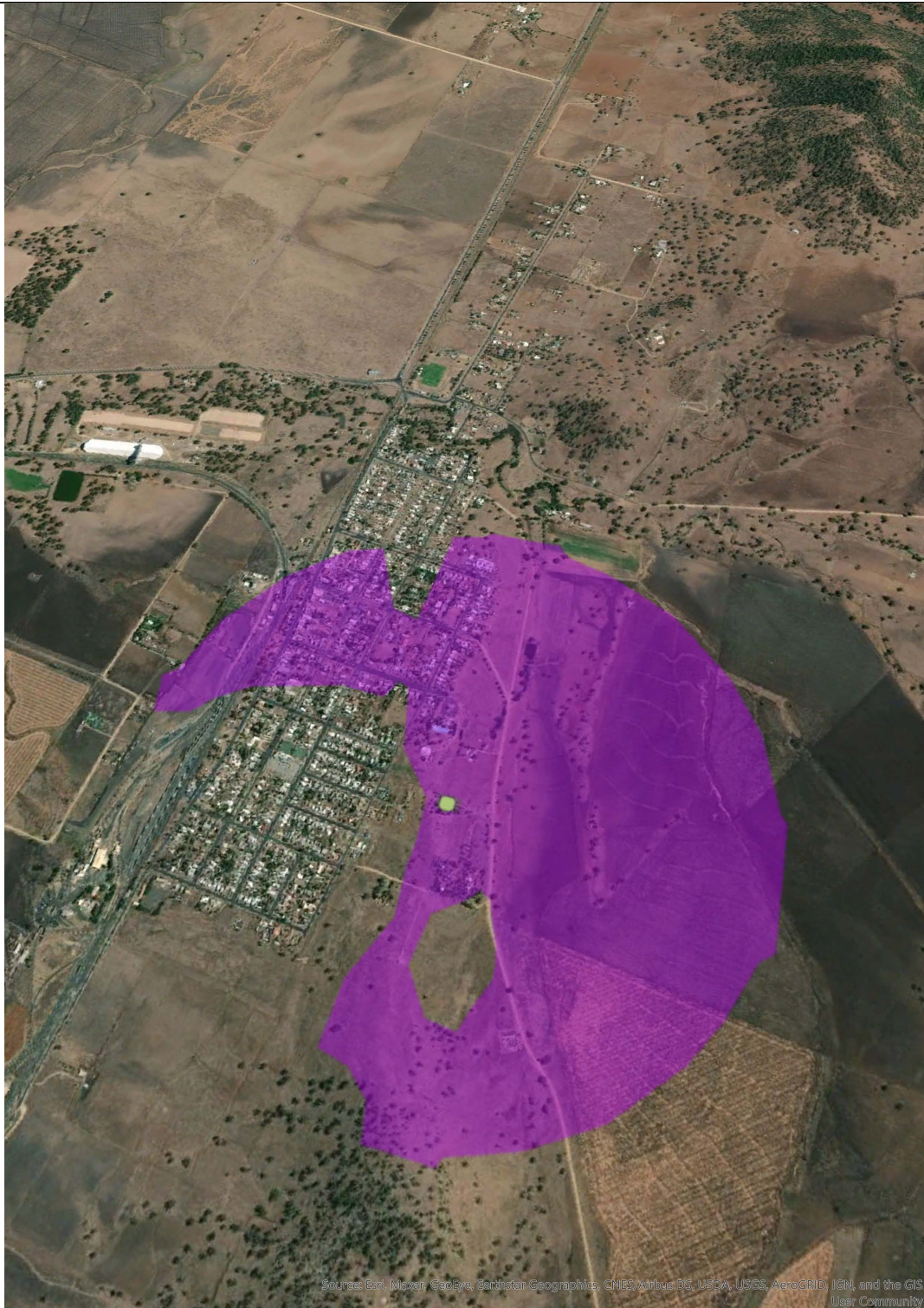
Locality Plan

Scale @ A4 1:1



Date produced: 28/9/2020
By: S.Gleeson-Willey

B. Viewshed Modelling



Wynergy Pty Ltd

Werris Creek 5MW Solar Farm
Viewshed - 172 Black Gully Road

Scale @ A4 1:8000 

Date taken: 28/8/2020
By: S.Gleeson-Willey



Source: Esri, DeLorme, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Wynergy Pty Ltd

Werris Creek 5MW Solar Farm

Viewshed - Anzac Parade, Werris
Creek

Scale @ A4 1:8000 

Date taken: 28/8/2020
By: S.Gleeson-Willey



Source: Esri, DeLorme, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Wynergy Pty Ltd

Werris Creek 5MW Solar Farm

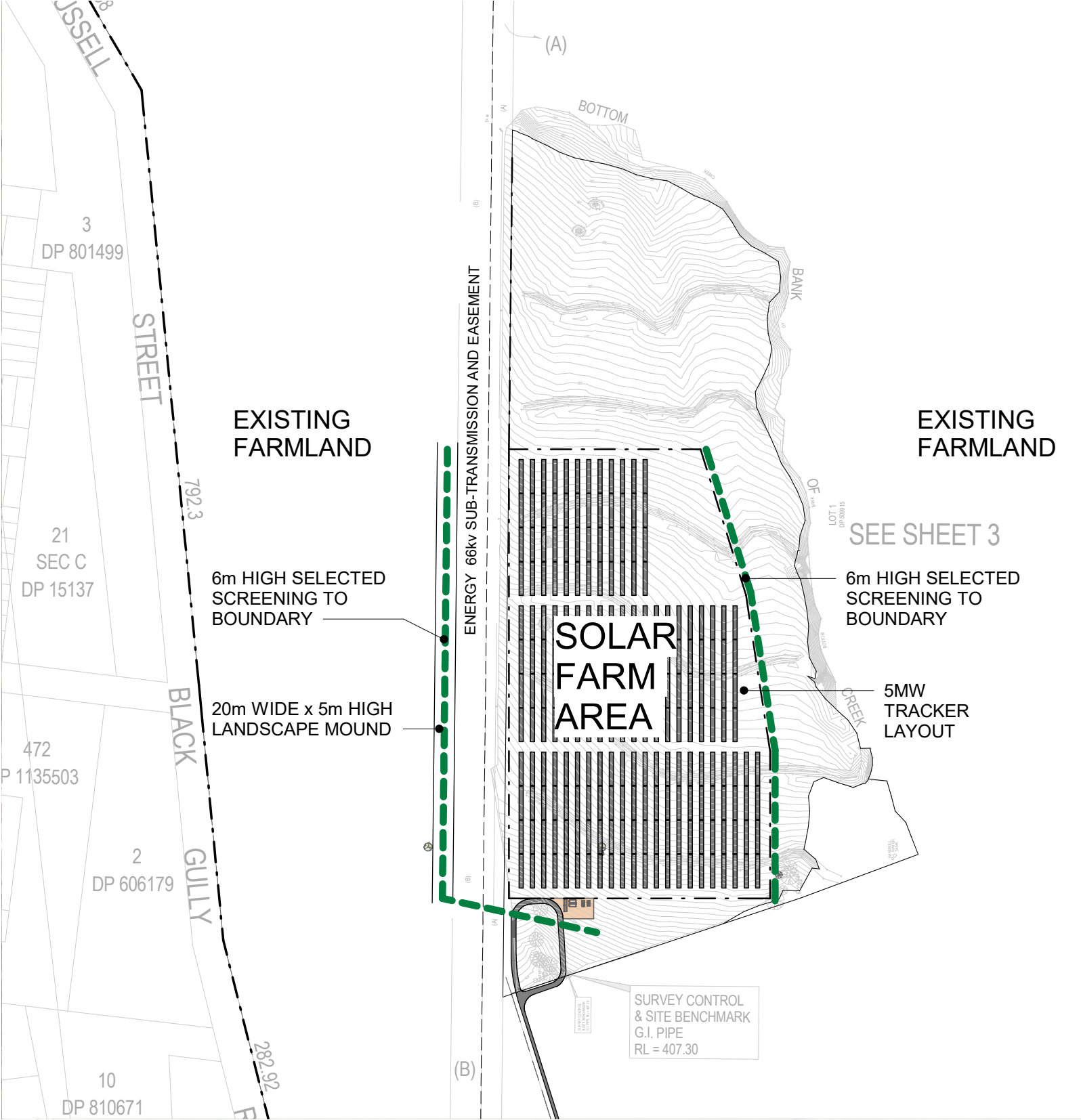
Viewshed - Glen Alpine Road, Werris Creek

Scale @ A4 1:8000 

Date taken: 28/8/2020

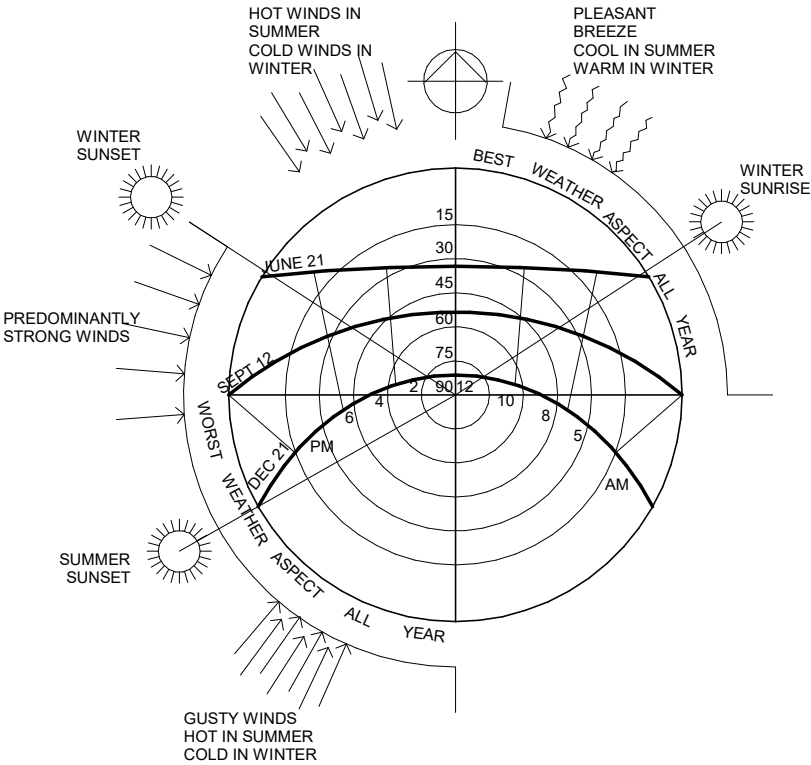
By: S.Gleeson-Willey

C. Proposed Infrastructure Layout



LANDSCAPE PLAN - 5MW LAYOUT

1 : 5000



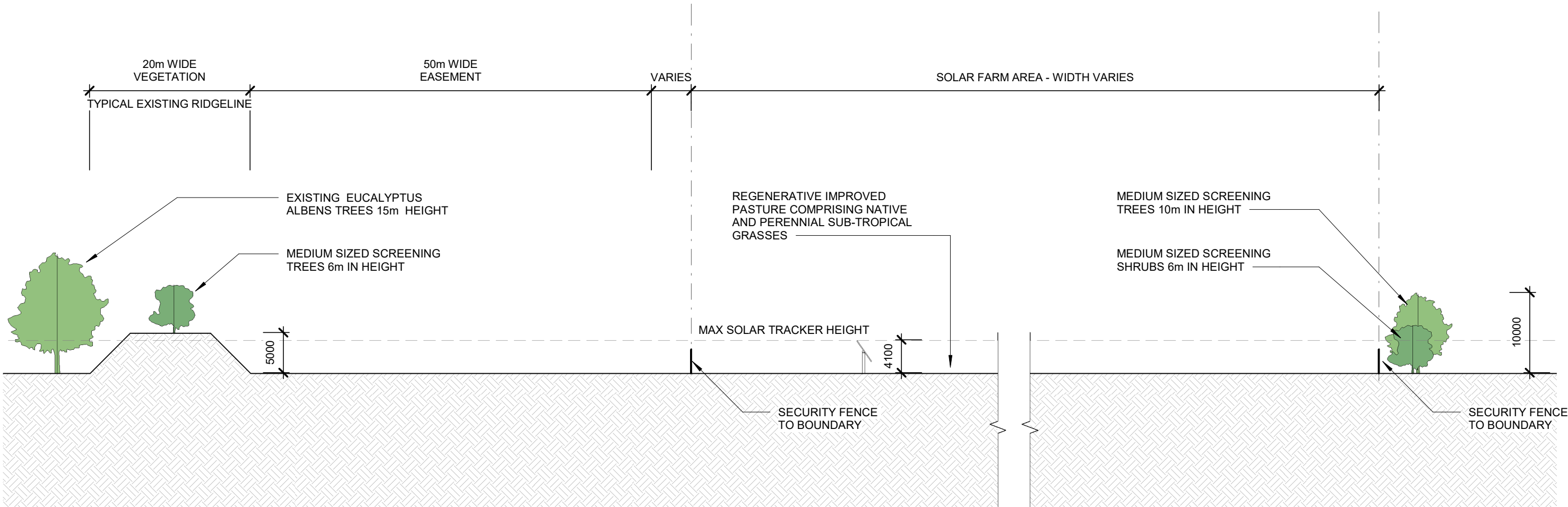
NOTES:

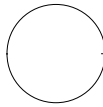
- ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SHOWN.
- WORK TO FIGURED DIMENSIONS, DO NOT SCALE FROM DRAWINGS.
- CHECK ALL DIMENSIONS ONSITE PRIOR TO CONSTRUCTION.
- REPORT ANY DISCEPENCIES TO OWNER.

ALL BUILDING WORKS TO COMPLY WITH THE BUILDING CODE OF AUSTRALIA AND ALL RELEVANT AUSTRALIAN STANDARDS.

MENZ SOLAR FARM PTY LTD; SUPPORTED BY WYNERGY PTY LTD PROPOSED 4.995MWAC / 5.2MWAC AGRIVOLTAIC SOLAR FARM LOT 1 DP 509915 BLACK GULLY ROAD WERRIS GREEK NSW 2341	LANDSCAPE PLAN - 5MW LAYOUT		L01	
	Project number	J250		WYNERGY     DANIEL LAWLESS DRAFTING SERVICE 23 Terence St, Adamstown Heights E: dklawless@gmail.com P: 0413 013 187 ABN: 63 885 522 688
	Date	01-09-20		
	Drawn by	DKL		
	Scale	As indicated		

4	DA APPLICATION	22/09/20
3	DA APPLICATION	21/09/20
2	MINOR REVISION	09/09/20
1	MINOR REVISION	07/09/20
No.	Description	Date



 **TYPICAL LANDSCAPE SECTION - BOUNDARY TREATMENT**
1 : 500

NOTES:

- ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SHOWN.
- WORK TO FIGURED DIMENSIONS, DO NOT SCALE FROM DRAWINGS.
- CHECK ALL DIMENSIONS ONSITE PRIOR TO CONSTRUCTION.
- REPORT ANY DISCEPENCIES TO OWNER.

ALL BUILDING WORKS TO COMPLY WITH THE BUILDING CODE OF AUSTRALIA AND ALL RELEVANT AUSTRILIAN STANDARDS.

3	DA APPLICATION	22/09/20
2	DA APPLICATION	21/09/20
1	MINOR REVISION	09/09/20
No.	Description	Date

MENZ SOLAR FARM PTY LTD; SUPPORTED BY WYNERGY PTY LTD PROPOSED 4.995MWAC / 5.2MWAC AGRIVOLTAIC SOLAR FARM LOT 1 DP 509915 BLACK GULLY ROAD WERRIS GREEK NSW 2341	LANDSCAPE SECTION		L03
	Project number	J250	WYNERGY DANIEL LAWLESS DRAFTING SERVICE 23 Terence St, Adamstown Heights E: dklawless@gmail.com P: 0413 013 187 ABN: 63 885 522 688
	Date	01-09-20	
	Drawn by	DKL	
	Scale	1 : 500	

0419 444 669| Moss Environmental



WASTE MANAGEMENT PLAN

Establishment of a Solar PV Power Generation Plant

962 Black Gully Road, Werris Creek NSW 2341

KDC

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Address: 962 Black Gully Road, Werris Creek NSW 2341

Proposal: Establishment of 5MW Solar PV Power Generation Plant.

OBJECTIVES FOR THE WASTE MANAGEMENT ON THIS SITE

- + To minimise resource requirements and construction waste through reuse and recycling; and the efficient selection and ordering of resources.
- + To ensure ongoing waste is properly managed and disposed.

The management of waste is addressed in this WMP in the following sections, according to the stages of the development: site preparation and construction and ongoing operation.

1 CONSTRUCTION STAGE

Construction waste will be separated on site by builder's contractors and builder's laborer's during the construction stage which is expected to be approximately 6 months. The site manager will erect a sign on site for waste areas and will set aside on site an area to store the recyclable materials for transportation to local recycling plants, separate from general waste. The site manager and/or builder will impose the execution of the waste separation policy on a regular basis and have on-going checks.

Stockpiles shall be located and managed appropriately to prevent sediment runoff and ensure minimal environmental impact from the building site.

A suitable all-weather vehicular access point shall be provided for the construction phase from Black Gully Road, and suitable sediment and erosion control devices implemented on site prior to commencement of construction works.

Type of waste generated	Estimates Volume in m ³ or area m ² or weight in tonne (t)	Reuse and Recycling		Disposal
		On-Site	Off-Site	
Excavated Material	<10m ³	Possible reuse of soil for backfilling purposes.	Un-recyclable excavated material to be disposed at local waste facility.	-
Metal (Ferrous) E.g. Steel	2.7t	-	Sent to local metal recycler by contractor.	-
Metal (Non-ferrous) E.g. Aluminium	<1t	-	Sent to local metal recycler by contractor.	-
Packaging (Wood) E.g. Pallets, dunnage	36.1t	-	Reuse by logistics contractor. Broken directed to recycler.	-
Packaging (Other) (Plastic, cardboard etc.)	4.4t	-	Cardboard/paper sent to recycler by contractor.	Disposed of at local waste facility by contractor
Other waste e.g. pvc plastics, paint, paper / cardboard	<2t	-		Disposed of at local waste facility by contractor

2 OPERATION STAGE

Operational waste is expected to be significantly minimal given that the operation will have no permanent staff on site. Maintenance checks/visits will be undertaken on an as needs basis and all waste from personnel at the site will be taken off site with no permanent storage of waste on site.

Green waste associated with mowing/weeding activities will be deposited onsite and composted in sustainable manner.