

STATEMENT OF ENVIRONMENTAL EFFECTS

Establishment of Solar PV Power Generation Plant
Lot 211 in DP 1069964, Country Road,
Westdale NSW 2340

PREPARED FOR PROVIDENCE ASSET GROUP | APRIL 2020

KDC

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1 INTRODUCTION

This Statement of Environmental Effects (SEE) is submitted to Tamworth Regional Council (Council) in support of a Development Application (DA) for a solar photovoltaic (PV) power generation plant at part Lot 211 in DP1069964, Country Road, Westdale NSW 2340 (the site).

Specifically, the proposed development includes:

- Establishment of a grid-connected solar photovoltaic (PV) plant including associated electrical generation, supplying no greater than 5 megawatts (MW);
- New 4m wide access road which will be connected to the approved internal road on-site shared with NSW Rural Fire Service (RFS);
- Security fencing 2.2m high; and
- Other associated site improvements as shown on the Plans at Appendix A.

This SEE has been prepared by KDC Pty Ltd (KDC) on behalf of Providence Asset Group (PAG). It describes the site, its environs, the proposed development and provides an assessment of the proposal in terms of the matters for consideration under Section 4.15 (1) of the Environmental Planning and Assessment Act 1979 (EP&A Act 1979). It should be read in conjunction with the supporting information and plans prepared by RINA Consulting appended to this report (Appendix A).

1.1 SITE BACKGROUND

The site is owned by Tamworth Regional Council and has historically been operated as a quarry site. The quarry has largely been restricted to the centre and southern portions of the site with no development in the northern portion of the site. It is noted that the quarry is still operating.

NSW Rural Fire Service has received approval for a new 'Fire Control Centre and Helipad' development located on the north western corner of the site under DA2016/0333 with a subsequent modification lodged as MOD2018-0126 has not yet been determined. The proposed development relies on DA2016/0333 (as Modified under MOD2018-0126) with access from Country Road to be shared and an extension from the approved access road connecting to the solar PV farm.

1.2 CONSULTATION WITH COUNCIL

The proposed development was informally discussed with Tamworth Regional Council's representatives Sam Lobsey, Samson Weng and Anna La during a pre-development application meeting on 11 October 2019 for another solar project located in Manilla and informally on a separate occasion. In addition to the general Pre DA advice received, Council recommended that consultation be undertaken with relevant neighbours and RFS. It was also specifically recommended that due to the location of the site that a Visual Impact Assessment including photomontages be included in the DA package. It is noted that consultation with neighbours and RFS has been undertaken prior to lodging this application. A Visual Impact Assessment is also attached at Appendix E.

Table 1 summarises the general matters raised by Council at the previous advisory meeting and provides comments on each of the matters raised.

Table 1 – Pre-DA Consultation with Tamworth Regional Council

Matters Raised	Comments
Access and Traffic + Traffic Assessment Report is required – assessment impacts are to be based on vehicle movements at peak periods and when the number of vehicles on site will be at the greatest	A Traffic Impact Assessment (TIA) has been undertaken for the proposed development provided at Appendix D.
Cost of Works + Quantity Survey Report is required – currently estimated between $5-$10 million depending on provision of battery storage and depth of footings	A Detailed Cost Summary Report and Capital Investment Value Report have been prepared by a registered surveyor and are provided at Appendix N.
Detention Basin + Detention Basin (sediment basin) has been proposed. Needs to detain stormwater runoff and design the basin outlet to bring the discharge rate back to pre-developed flow rate.	A Stormwater Management Plan has been provided at Appendix B. The development will achieve pre-development flow rate through the provision of a stormwater detention basin in the laydown area.
Environmental and Heritage Impact + Applicant needs to ensure assessment demonstrate understanding of the potential impacts on the creek system and other environmental impacts that are not visible due to the drought + Environmental Impact Assessment and Aboriginal Heritage Impact Assessment are required at DA lodgement + An assessment of the development in relation to the Biodiversity Conservation Act 2016 is required to be provided. + Positive environmental outcomes can be included in the Statement of Environmental Effects	A wide range of environmental safeguards will be undertaken, as detailed within this SEE. An Aboriginal Due Diligence Assessment has been provided at Appendix H. An Ecological Assessment Report has been provided at Appendix J. Discussion of environmental impacts have been provided at Section 5 of this SEE.
Noise Impacts + Greatest amount of noise is expected during construction. + Applicant has stated energy generation is during daytime only and generates minimal audible sound. + Noise Impact Study is to be submitted at DA lodgement.	A Noise Assessment for the works has been provided at Appendix I.
Plans Required at DA Lodgement (e.g. site plan, floor plan, elevation, engineering) + All buildings/structures including control room and substation + Landscape Plan + Details of footings + Location of security fence to be included on site plan	Appropriate development plans which include security fence location and details of footings have been provided at Appendix A. A Landscape Plan has been provided at Appendix F.
Social Impact + Social Impact Statement is to be submitted at DA lodgement. + Positive community outcomes can be included in Statement of Environmental Effects.	A Social Impact Statement (SIS) has been provided at Appendix K. Positive outcomes for the community have been discussed within the SIS and Section 5.9 of this SEE.

Matters Raised	Comments
Visual Impacts + Concerns regarding glare and reflectivity – whether valid or perceived – can deter community support. Applicant has also stated proposed system is different to the PEG system which can create glare. + Applicant is recommended to include this information in their Statement of Environmental Effects. Early community engagement and education will enable an informed notification/advertisement period. + Photos or rendered images of the project from vantage points of concern (e.g. from the village, from the road) will enable clear understanding of the project's visual impact rather than depending on subjective interpretation of written description.	A Visual Impact Assessment has been provided at Appendix E that includes rendered images from surrounding viewpoints. Glare impacts have been assessed with a Reflectivity Report provided at Appendix L. Glare generated by the proposed development is expected to be low.

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2 THE SITE AND SURROUNDS

2.1 SITE DESCRIPTION

The land is legally known as part Lot 211 in DP 1069964 and is generally referred to as Country Road, Westdale NSW 2340 (refer to Figure 1). The land is currently used for an extractive industry (quarry) with good grass coverage surrounding the area of ground disturbance. In terms of topography, the site slopes from the northwest to the southwest at grades of approximately 3.0% to 3.5%.

The lot consists of a large rural type lot which contains a quarry development covering the central and southern parts of the site. A low number of scattered trees are present on the site with the site consisting of predominantly low grassland outside of the quarry area.

The lot is generally regularly shaped with a separate lot forming the south western corner. The area of the proposed solar PV farm is identified in Figure 1 below and is approximately 13.25 hectares. The development area has an existing first order stream located in the northern section, which is illustrated in cadastral image shown at Figure 2.

Access to the existing quarry is provided via an existing crossover from Country Road located at the north western corner of the lot.

Figure 1 – Locality Plan (Source: Six Maps)

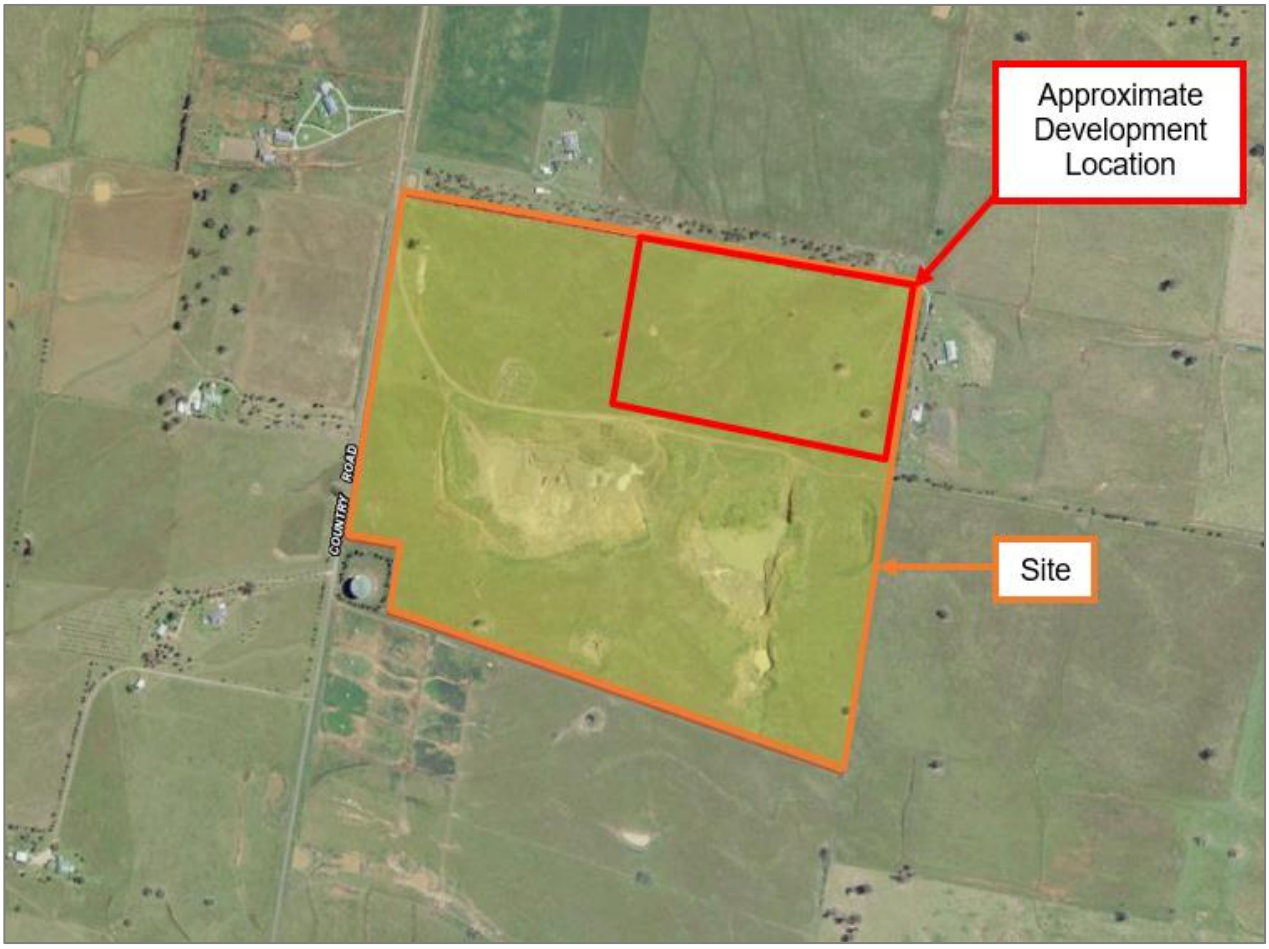
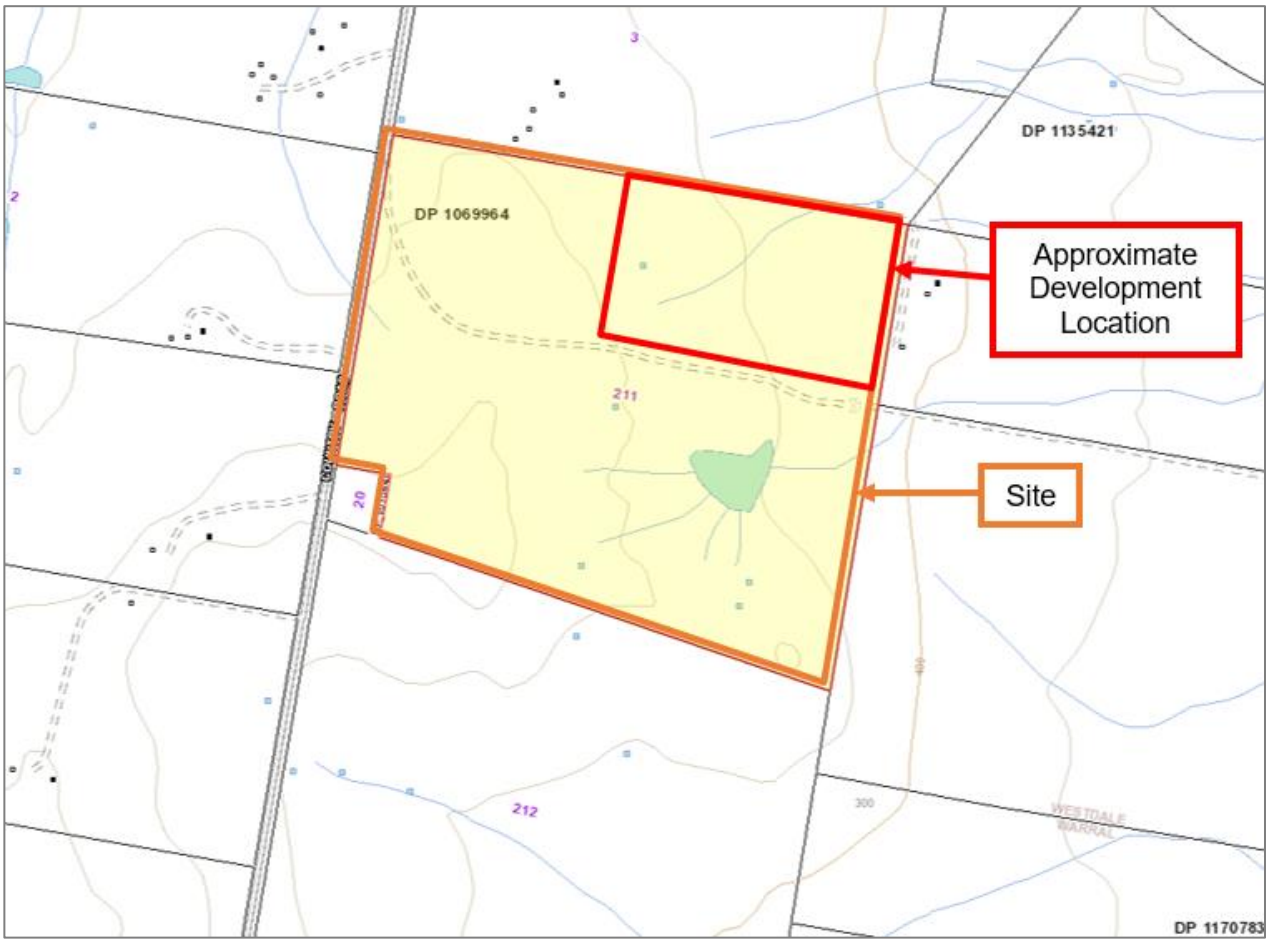


Figure 2 – Cadastral Plan (Source: Six Maps)



2.2 SITE LOCATION AND CONTEXT

The site is located on the eastern side of Country Road, within the Tamworth Regional Council Local Government Area (LGA) (refer to Figure 1). It is approximately 1.5km south of the junction of Country Road and Oxley Highway.

Near the site, Country Road is a local sealed rural road with its primary function to provide vehicular access to properties along its length though it also performs as a collector road in distributing local traffic to the arterial road network at the Oxley Highway. Country Road is a local road under the care and control of Council and a has 70 km/hr speed zoning.

The surrounding area is made up of large rural lots generally containing a rural type land use typically with a single dwelling house. The Tamworth Airport is located approximately 2.3km to the north west of the site.

A residential dwelling abuts the site to the east; a buffer (approx. 80m) is proposed between the proposal and existing residential dwelling. Perimeter fencing and the existing tree line will provide a visual and physical buffer between the two uses.

3 PROJECT DESCRIPTION

The South Tamworth Solar Farm project is one of of PAG's community solar initiatives to be rolled out across regional Australia, with multiple benefits for rural and regional communities.

The proposal includes a no larger than 5MW grid-connected solar PV installation. Once established, the solar farm will be connected to the adjacent 11 kV powerline originating from the Essential Energy South Tamworth Zone Substation. It is proposed to connect into the electrical transmission grid via the existing transmission lines which run along the northern boundary of the site. It is noted that a separate application process will be undertaken with Essential Energy for this connection.

The proposed development aims to erect approximately 14,196 solar PV panels producing 425W. Other electrical generation infrastructure is proposed on the site including a skid-mounted MV Power Station consisting of inverters, transformer and switchgear. Due to the capacity of the inverter system, the proposed development will produce less than 5MW. Most of the infrastructure would be pre-fabricated off-site, delivered and assembled on-site.

The PV arrangement will consist of 204 ground mounted single axis trackers. The PV arrays will have a clearance above the existing ground surface and extend to approximately 2.727m at maximum tilt. The PV mounting structure would comprise steel posts driven to approximately 1.5m below ground using a small pile driver. Additional support structures will be attached to the piles, which would then support the PV panels.

The proposed development will not require the entire removal of vegetation within the development area given the subject site has previously been cleared of native vegetation for agricultural development and for the quarry. Remaining native vegetation consists of areas of native and exotic grassland and isolated mature trees. The proposal seeks approval to remove approximately 37 mature trees and large shrubs along with patchy shrubbery. The proposal will not involve clearing of native vegetation that exceeds the Biodiversity Offset Scheme (BOS) threshold for the site. To reiterate, vegetation located within the rows of solar panels will not be removed as part of the proposed development.

A 4m wide access road is proposed connecting the solar farm to the approved internal road and access approved under DA2016/0333, see Figure 4. This arrangement will share a single access point to Country Road at the northern area of the larger lot with the approved RFS facility. The solar farm will be fully fenced with 2.2m security fencing including barbed wire at the top. Gate access is provided on the western boundary. A car park area, off load area and construction laydown area are indicatively located on the General Arrangement Plan (refer to Figure 3). Motion activated security lighting may be installed at the site.

A stormwater management system is proposed including an onsite detention basin holding a total volume of 256.362m^3 supported with a low flow outlet. Refer to the Stormwater Management Plans at Appendix B. Earthworks for the project are generally limited to the establishment of the access road, drainage swales and batters, laydown area, and detention basin.

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.

During the construction period there is estimated to be up to 30 personnel on site for up to 6 months.

Figure 3 – Proposed Development Layout

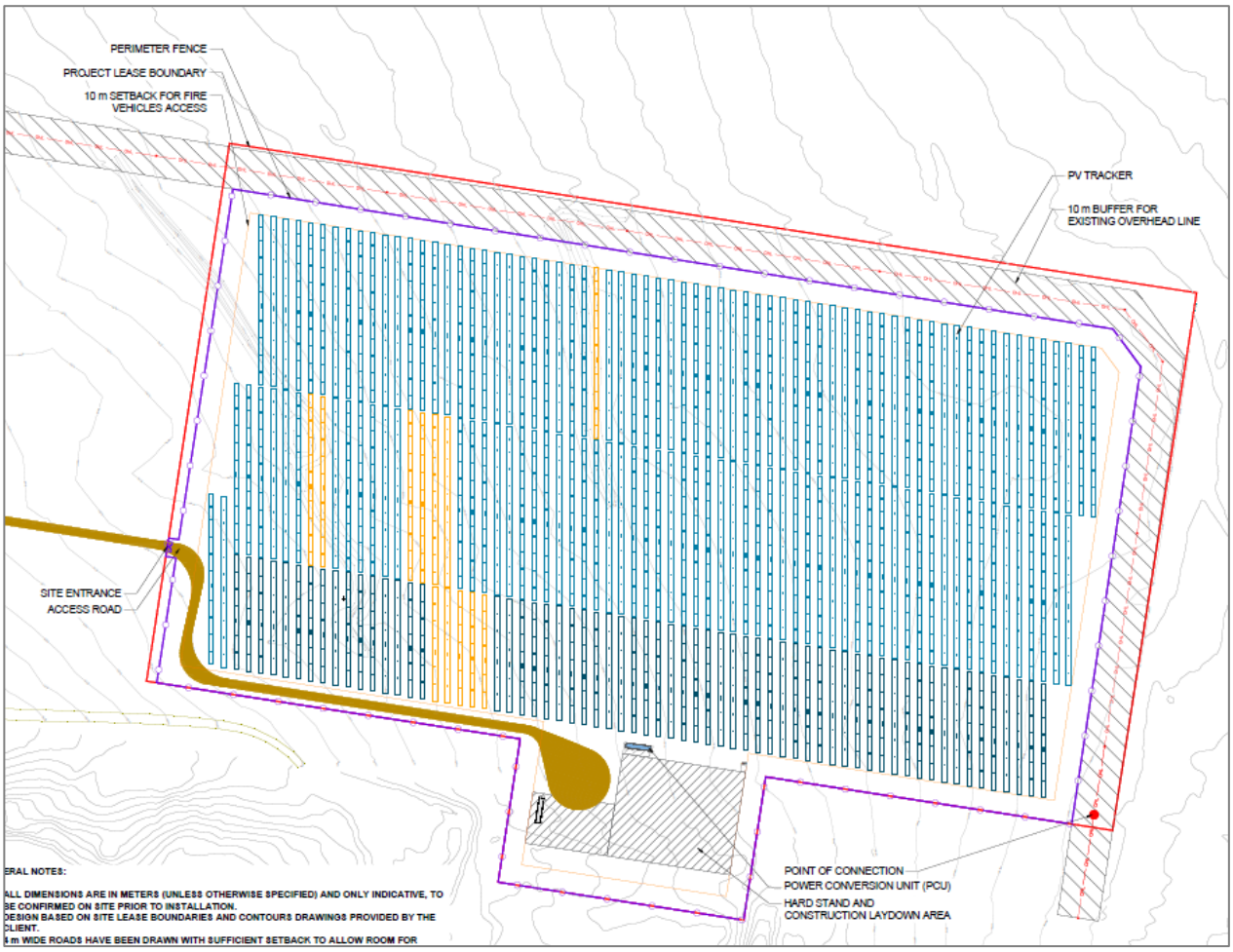
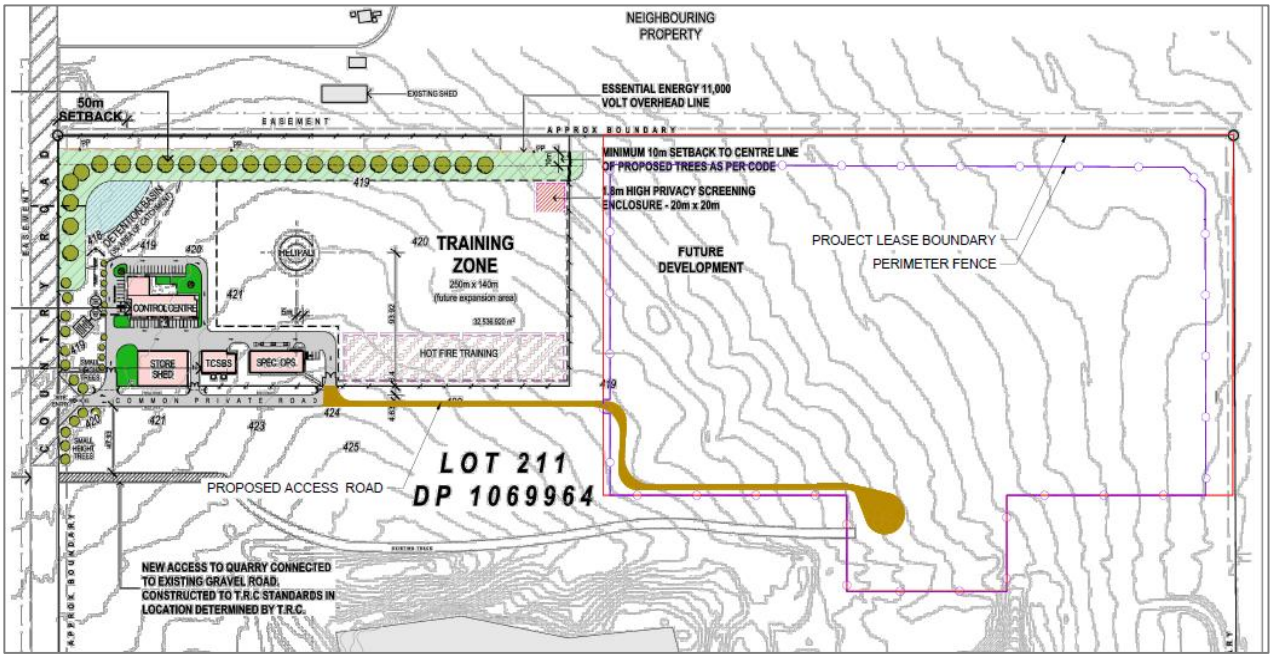


Figure 4 – Proposed Access Arrangement



4 RELEVANT LEGISLATION AND PLANNING CONTROLS

The following Environmental Planning Instruments (EPIs) and Development Control Plans (DCPs) are relevant to the proposed development as explored within this Section of the report:

- Environment Protection and Biodiversity Conservation Act 1999;
- Environmental Planning and Assessment Act 1979;
- Water Management Act 2000;
- National Parks and Wildlife Act 1974;
- Biodiversity Conservation Act 2016;
- State Environmental Planning Policy (Infrastructure) 2007;
- State Environmental Planning Policy (Koala Habitat Protection) 2019;
- State Environmental Planning Policy (State and Regional Development) 2011;
- State Environmental Planning Policy 55 – Remediation of Land;
- Tamworth Regional Local Environmental Plan 2010;
- Tamworth Regional Development Control Plan 2010; and
- Tamworth Regional Development Strategy.

4.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

Consideration of the EPBC Act 1999 revealed that impacts on Matters of National Environmental Significance (MNES) are unlikely to occur. No EPBC listed species, ecological communities, 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.

Full details are included in the Ecological Assessment Report at Appendix J.

4.2 ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

The proposal, as with all development applications, is subject to the provisions of the Environmental Planning and Assessment Act 1979 (EP&A Act). Section 4.15(1) of the EP&A Act, 1979 provides criteria which a consent authority is to take into consideration, where relevant, when considering a DA. An assessment of the subject DA, in accordance with the relevant matters prescribed under Section 4.15(1), is provided within this SEE.

It is noted, pursuant to Section 4.46 of the EP&A Act 1979, the proposed development does trigger integrated development.

Section 4.46 What is "integrated development"?

An unnamed stream is located in the north eastern corner of the site within the bounds of the development with works to be located in close proximity to the creek. As a result, the development may require an activity approval under the Water Management Act 2000 from the NSW Department of Planning, Industry and Environment Water Division qualifying as Integrated Development.

4.3 WATER MANAGEMENT ACT 2000

The development application is classified as Integrated Development pursuant to Section 4.46 of the EP&A Act 1979 and therefore requires approval under the Water Management Act 2000.

An unnamed first order stream transcends the development area. 'Controlled Activity Permit' is required for certain types of development of activities carried out within 40 metres of a river, lake or estuary. The unnamed steam forms part of a 'river,' as defined under the Water Management Act 2000. During the referral period, Council will refer this development application to the NSW Department of Planning, Industry and Environment Water Division for further consideration.

4.4 NATIONAL PARKS AND WILDLIFE ACT 1974

The National Parks and Wildlife Act 1974 includes provisions for the protection and recording of Aboriginal objects in NSW. An Aboriginal Due Diligence investigation has been undertaken in accordance with the provisions of the National Parks and Wildlife Regulations 2009 and the accompanying Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (OEH 2010). See Appendix H for a copy of the Due Diligence Report for the proposal prepared by Virtus Heritage.

4.5 BIODIVERSITY CONSERVATION ACT 2016

The Biodiversity Conservation Act 2016 (BC Act 2016) aims to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. To achieve its goals, the BC Act 2016 governs endangered species and communities and provides a framework for a Biodiversity Offset Scheme.

An assessment was undertaken by Kleinfelder in accordance with Section 7.3 of the BC Act 2016 to determine the significance of potential impacts of the proposed development on any threatened species or communities which are listed within the Act.

No threatened ecological communities or any listed flora or fauna were identified on site with the proposed development unlikely to cause any significant impact to any threatened species, populations or communities listed within the BC Act. Entry into the NSW BOS is not triggered by the proposed development. Further details are provided in Section 5.5 of this Report.

4.6 STATE ENVIRONMENTAL PLANNING POLICY (STATE AND REGIONAL DEVELOPMENT) 2011

Regional development classification applies to both local and designated development applications exceeding certain criteria defined by Schedule 7 of the SEPP SRD.

3 Council related development over $5 million

Development that has a capital investment value of more than $5 million if—

> *(a) a council for the area in which the development is to be carried out is the applicant for development consent, or*
>
> *(b) the council is the owner of any land on which the development is to be carried out, or*
>
> *(c) the development is to be carried out by the council, or*
>
> *(d) the council is a party to any agreement or arrangement relating to the development (other than any agreement or arrangement entered into under the Act or for the purposes of the payment of contributions by a person other than the council).*

With a CIV greater than $5 million and the land owned by Tamworth Regional Council the development is deemed to be regionally significant development and the application will therefore be referred to the Joint Regional Planning Panel (JRPP) for determination.

5 Private infrastructure and community facilities over $5 million

Development that has a capital investment value of more than $5 million for any of the following purposes:

> *(a) air transport facilities,* ***electricity generating works****, port facilities, rail infrastructure facilities, road infrastructure facilities, sewerage systems, telecommunications facilities, waste or resource management facilities, water supply systems, or wharf or boating facilities,*
>
> *(b) affordable housing, child care centres, community facilities, correctional centres, educational establishments, group homes, health services facilities or places of public worship.*

The proposed development is also considered to be private infrastructure with a CIV greater than $5 million and as a result the development is deemed to be regionally significant development and the application will be referred to the JRPP for determination.

4.7 STATE ENVIRONMENTAL PLANNING POLICY (INFRASTRUCTURE) 2007

Clause 45 Determination of development applications—other development

The proposed development will require works to connect to the overhead electricity power lines and as a result constitutes works within 5m of powerlines. Transmission lines are noted as being present on the site supported with an easement for transmission. Due to the location and nature of the proposed development referral to the electricity supply authority, Essential Energy, will be required during the assessment period.

Clause 104 - Traffic-generating development

The proposed development will not generate greater than 50 vehicle movements per hour and as such does not trigger traffic generating development under the SEPP. Referral under this clause to the RMS is therefore not required.

4.8 STATE ENVIRONMENTAL PLANNING POLICY (KOALA HABITAT PROTECTION) 2019

Tamworth Regional Council does possess a Koala Plan of Management; therefore, the Koala Habitat Protection SEPP 2019 applies to the site.

The Koala Development Application Map shows that some vegetation within the site is considered Koala Habitat (see Figure 5), with a number of the proposed trees to be removed identified as White Box *Eucalyptus albens* which is listed as a Preferred Koala Feed Tree under Schedule 2 of the SEPP.

Figure 5 – Koala Development Application Map Spatial Viewer Extract



An assessment of Koala habitat within the subject site by Kleinfelder determined that no Highly Suitable Koala Habitat, or Core Koala Habitat is present. There was no evidence of resident populations of Koalas during the investigation with only one historical record of a Koala located within a 5km area. The feed trees present on site are isolated and unlikely to be fed upon by Koalas.

As a result, further assessment under the SEPP Koala Habitat Protection is not considered to be required.

4.9 STATE ENVIRONMENTAL PLANNING POLICY NO 55 REMEDIATION OF LAND

This SEPP requires the consent authority to consider the potential contamination status of the land prior to approving the development. Noting that the land has been historically used for agriculture (farming), it is unlikely that contamination requiring remediation exists.

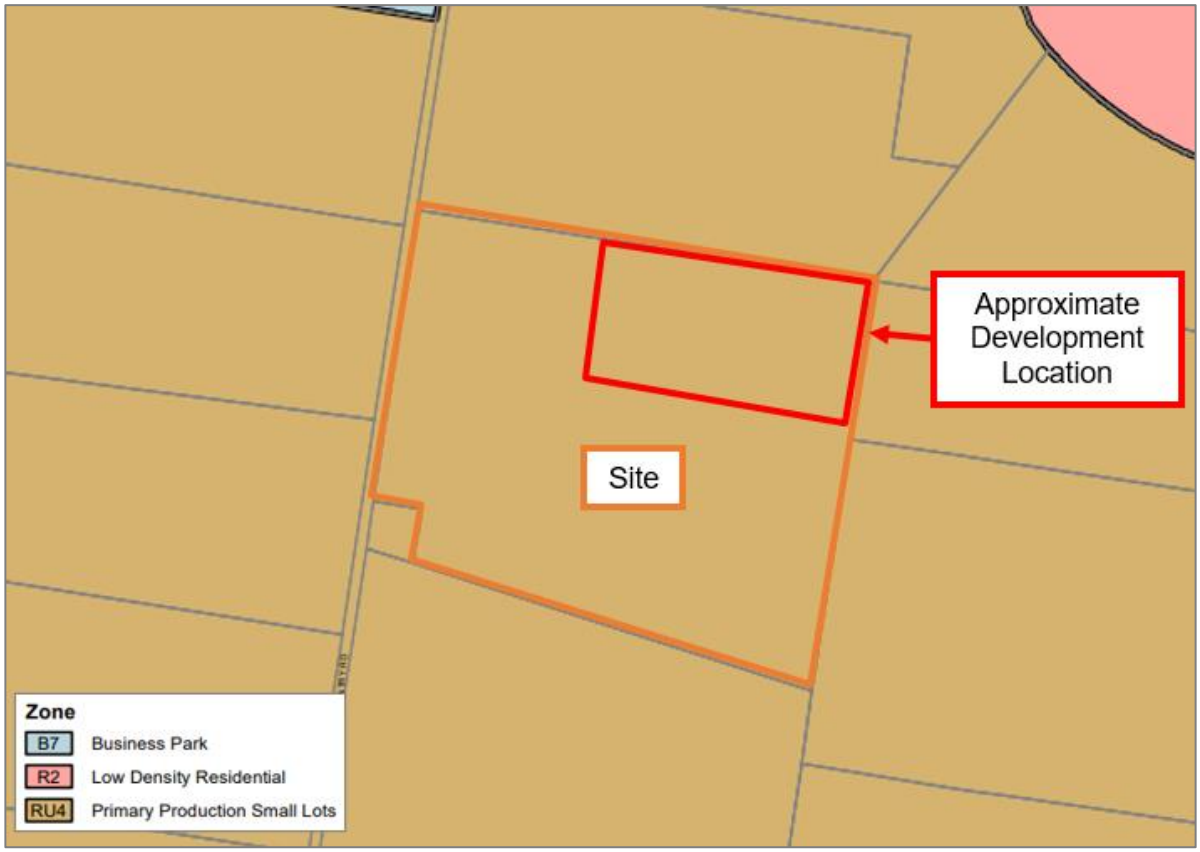
Furthermore, a search of the NSW EPA's *'List of NSW contaminated sites notified to the EPA'* and *'POEO Public Register'* has been undertaken which revealed no contaminated sites listed in or around the site and no licences provided under the Protection of the Environment Operations Act were noted in proximity to the site.

The proposed development is not considered to be sensitive in nature and as a result is considered to be appropriate for the site in its current site in accordance with SEPP 55.

4.10 TAMWORTH REGIONAL LOCAL ENVIRONMENTAL

The site is zoned RU4 Primary Production Small Lots under the Tamworth Regional Local Environmental Plan 2010 (LEP 2010), see Figure 6.

Figure 6 – Land Zone Extract Tamworth Regional LEP 2010 (LNZ_004C)



Zone RU4 Primary Production Small Lots

1 Objectives of zone

- *To enable sustainable primary industry and other compatible land uses.*

- *To encourage and promote diversity and employment opportunities in relation to primary industry enterprises, particularly those that require smaller lots or that are more intensive in nature.*

- *To minimise conflict between land uses within this zone and land uses within adjoining zones.*

2 Permitted without consent

Environmental protection works; Extensive agriculture; Home-based child care; Home occupations; Moorings; Roads

3 Permitted with consent

Agricultural produce industries; Aquaculture; Cellar door premises; Dual occupancies (attached); Dwelling houses; Farm buildings; Intensive plant agriculture; Kiosks; Landscaping material supplies; Light industries; Markets; Plant nurseries; Roadside stalls; Rural workers' dwellings; Any other development not specified in item 2 or 4

4 Prohibited

Amusement centres; Backpackers' accommodation; Cemeteries; Centre-based child care facilities; Commercial premises; Crematoria; Eco-tourist facilities; Entertainment facilities; Exhibition villages; Heavy industrial storage establishments; Home occupations (sex services); Industrial retail outlets; Industrial training facilities; Industries; Intensive livestock agriculture; Mortuaries; Recreation facilities (major); Registered clubs; Residential accommodation; Respite day care centres; Restricted premises; Rural industries; Service stations; Serviced apartments; Sex services premises; Storage premises; Vehicle body repair workshops; Vehicle repair stations; Wharf or boating facilities; Wholesale supplies

The proposed land use, defined as electricity generating works, is permitted on the site with consent as *Any other development not specified in item 2 or 4*.

Definition:

electricity generating works means a building or place used for the purpose of making or generating electricity.

The proposed development is consistent with the objectives of the RU4 Primary Production Small Lots zone as it will provide a rural compatible land use contributing to the diversity of primary industry enterprises in the area. The development will generate short term construction employment opportunities and contributes little land use conflict with adjoining properties and land uses. The development will not generate inappropriate traffic on Country Road nor will it generate excessive noise, vibration or dust emissions.

Clause 4.1 Minimum Lot Size Clause 5.10 Heritage Conservation

The site is not a listed heritage item nor are any listed heritage items located in proximity to the site. The site is not mapped as a heritage conservation area.

Clause 7.1 Earthworks

The objectives of this clause are:

> *(a) to ensure that earthworks for which development consent is required will not have a detrimental impact on environmental functions and processes, neighbouring uses, cultural or heritage items or features of the surrounding land.*
>
> *(b) to allow earthworks of a minor nature without separate development consent*

Earthworks will primarily involve trenching which is required for cabling of each PV array/module to inverters and a substation. Other earthworks required to be undertaken include the establishment of the access road, drainage swales and batters, laydown area, and detention basin. Given the relatively small scale of earthworks proposed, the proposed development retains the natural landform as much as possible, limiting extent of cut and fill.

The earthworks proposed will result in minimal impact on the environmental functions and processes, neighbouring uses, cultural or heritage items or features of the surrounding land. Appropriate erosion and sediment controls will be employed. Refer to Appendix B for Civil Engineering Plans prepared by DRB consultant engineers.

Clause 7.2 Flood Planning

The site is not mapped within a flood prone land area under the LEP 2010. Notwithstanding, flood modelling has been undertaken by specialist flood consultants Torrent Consulting, refer to Flood Impact Assessment at Appendix G.

Clause 7.6 Development in flight path

The site is identified within a 15m above ground Obstacle Limitation Surface Height area under the LEP 2010, see Figure 7.

Figure 7 – Obstacle Limitation Surface Extract Tamworth Regional LEP 2010 (OLS_004C)



The objectives of Clause 7.6 are:

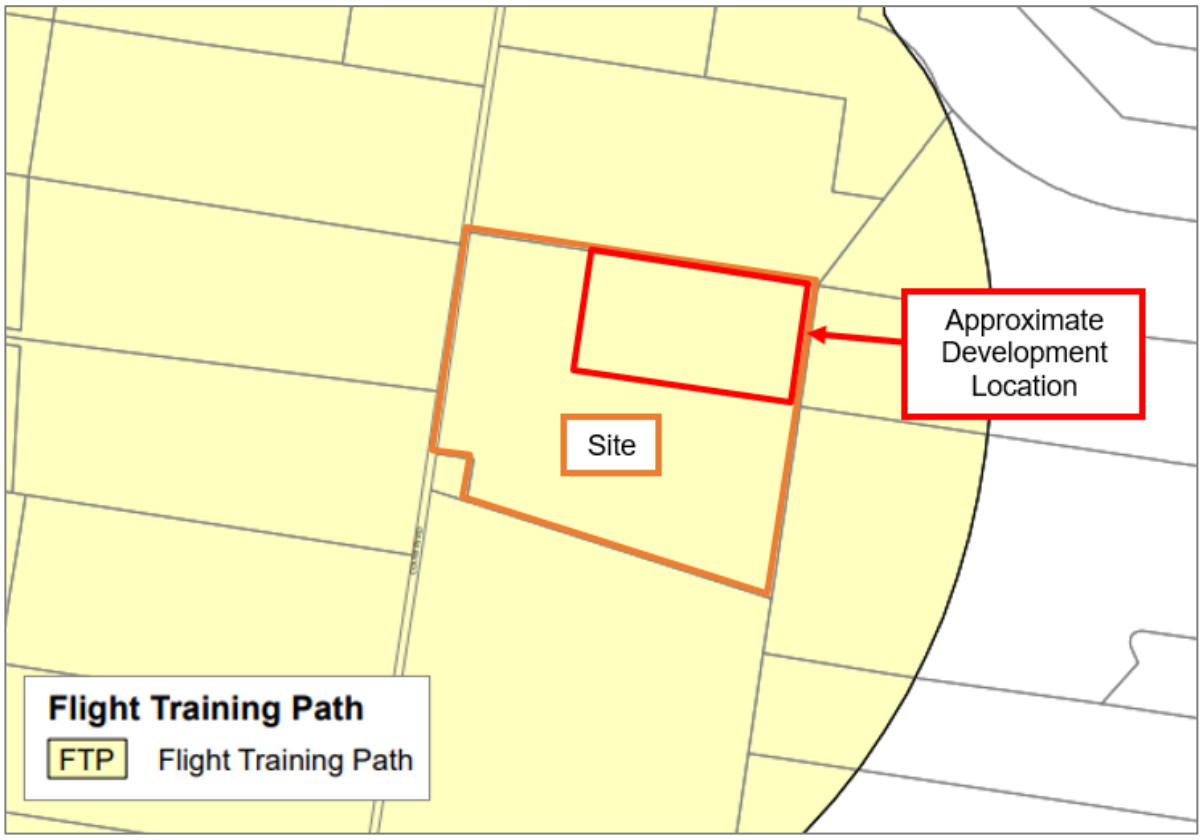
> *(a) to provide for the effective and on-going operation of the Tamworth Airport, and*
>
> *(b) to ensure that any such operation is not compromised by proposed development in the flight path of that airport.*

The proposed solar PV development will not exceed the 15m obstacle limitation surface for the Tamworth Airport nor will the structures be impacted by airport operations. However, due to the nature of the proposed development and its location within the flight path area, referral to the relevant Commonwealth body will be required as stipulated under clause 7.6(3).

Clause 7.7 Development in areas subject to aircraft noise

The site is located within a flight training path area under the LEP 2010, see Figure 8.

Figure 8 – Flight Training Path Extract Tamworth Regional LEP 2010 (CL2_004C)



The provisions for the Flight Training Path under Clause 7.7 relate to noise insulation of any building located within the area. As the proposed development relates to the establishment of a solar PV project, noise impacts on the development are not expected and as a result the proposal meets the relevant requirements of Clause 7.7.

4.11 TAMWORTH REGIONAL DEVELOPMENT CONTROL PLAN 2010

The Tamworth Regional Development Control Plan (DCP) 2010 applies to all land within the Tamworth Local Government Area (LGA), including the subject site. The following chapters of the DCP are relevant to the proposal:

- Step 3: General Development Specifications
  - Other Types of Development Controls
  - Environmental Controls
- Step 5: Discretionary Development Standards
  - Environmental Standards

The proposal has been designed to comply with the relevant controls contained within the DCP. A full assessment against the relevant components of the DCP is included in table format at Appendix C.

4.12 TAMWORTH REGIONAL DEVELOPMENT STRATEGY

The Tamworth Regional Development Strategy (RDS) provides an overall strategic plan to manage development in urban and rural areas to meet expected growth in the Tamworth Region.

The RDS promotes the protection of the environment and aims to minimise the impacts on climate change under Direction 8.2.1 Climate. The key relevant directions of the strategy revolve around climate and improving electrical infrastructure provisions.

The strategy recognises that forward planning and funding provision will need to be provided for regionally significant infrastructure projects if the region is going to successfully and sustainably harness its growth potential.

The directions of the strategy specifically call out the investigation of providing solar energy. As the scope of the South Tamworth Solar Farm project is to provide solar energy infrastructure, the works proposed will be consistent with the directions of the RDS and viewed favourably by Council in that regard.

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5 ASSESSMENT OF PLANNING ISSUES

The following is an assessment of the environmental effects of the proposed development as described in the preceding sections of this SEE. The assessment considers only those matters under Section 4.15(1) of the EP&A Act 1979 that are relevant to the proposal.

5.1 COMPLIANCE WITH PLANNING INSTRUMENTS AND CONTROLS

Unless otherwise stated, the proposed development either complies with or is consistent with all relevant planning instruments and controls set out in Section 4 of this SEE, in that:

- The proposed solar PV farm will have minimal impact on any potential listed flora or fauna under the BC Act 2016;
- The development is classified as Regional Development under SEPP State and Regional Development and will therefore be determined by the JRPP;
- The proposal complies with the requirements of SEPP Infrastructure and will referral to the road authority will not be required as the proposal is not classified as traffic generating development;
- The proposed Solar PV Farm is permissible within the RU4 Primary Production Small Lots zone under the Tamworth LEP 2010; and
- The proposal is generally consistent with the objectives and relevant controls within Tamworth Regional DCP 2010. A detailed assessment of the proposed development against the relevant provisions of the DCP is provided in the table at Appendix C.

5.2 TRAFFIC, ACCESS AND PARKING

Traffic

A Traffic Impact Assessment (TIA) has been undertaken by Intersect Traffic and is attached at Appendix D. The anticipated rates of traffic likely to be generated from the proposed development (both during construction and once operational) are discussed in this report, which relies on the advice from the applicant regarding construction and operation of the development.

The majority of traffic movements associated with the development will occur during the construction of the solar farm (approximate 6-month period) with the delivery of panels and prefabricated structural supports. Deliveries during construction works would be expected to be within rigid and articulated vehicles and the access road has been designed to safely accommodate these vehicles.

Traffic movements generated during operation would include a single staff light vehicle movement associated with maintenance inspections and specific maintenance work (on an as needs basis) which would be short term and infrequent.

Peak hour construction traffic has been calculated at 18 vehicle trips per hour consisting of 10 light vehicles, 3 roadwork vehicles, and 2 delivery vehicles. Based on the data collected from traffic surveys the surrounding road network has sufficient capacity to cater to the projected construction traffic with capacity to spare for future development in the area. It is noted that construction traffic is temporary in nature and will be managed through a future Construction Management Plan.

In summary, the additional traffic anticipated from the proposal has been assigned to the road network where it was found that the surrounding road network (both now and in 10 years) is capable of accommodating the expected additional traffic from the proposal.

Access and Internal Circulation

A 4m wide access road is proposed connecting the solar farm to the approved internal road and access approved under DA2016/0333. This arrangement will share a single access point to Country Road at the northern area of the larger lot with the approved RFS facility. The proposed access arrangement will provide for the turning movements of cars and service vehicles, in accordance with Council controls and the Australian Standard for Parking Facilities (Part 1: Off-street car parking and Part 2: Off-street commercial vehicle facilities), AS 2890.1:2004 and AS 2890.2 –2002.

Parking

The Tamworth Regional DCP 2010 sets out the relevant on-site car parking rates for land uses within the Tamworth area. The car parking rate for industrial development has been utilised in the absence of a specific parking rate.

Industrial

> *1 space per 75 m2 or 1 space per 2 employees whichever is greater;*

Calculation:

> 1 employee for day to day operations
>
> 1 / 2 = 1 (0.5) car parking spaces

Consideration of construction parking demand has also been considered with potential for up to 30 employees projected. A total of 20 car parks are to be provisioned within the laydown area with additional space afforded for potential onsite overflow if required. The car parking area would comply with the requirements of Australian Standard AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking with parking bay sizes 2.4 m x 5.4 m and aisle widths of 5.8 metres. Therefore, the on-site car parking is considered suitable for the development ensuring all vehicle movements to and from the site off Country Road will be undertaken in a forward direction.

5.3 STORMWATER, SOIL AND EROSION CONTROL

The proposed stormwater management system has been designed to reduce post-development flows to align with the pre-development conditions on the site. To achieve this, a detention basin is proposed adjoining the laydown area to the west. This basin provides a holding volume of 256.362m^3 and is supported with a low flow pipe and overflow weir. The stormwater management system proposed has been designed in accordance with Council requirements and with the proposed mitigation measures achieves compliance with the pre-development stormwater flows.

The stormwater drainage strategy for the development 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 grass-lined swales 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 South Tamworth Solar Farm will limit the Post-Development peak flows to Pre-Development flow rates for the 1 EY, 10% AEP and 1% AEP events.

Sediment control devices will be constructed, placed, and maintained in accordance with respective Council specifications and Landcom "Soil and Construction" manual. Temporary contractors' vehicular access to the site will be restricted to a single point with a vehicle shaker grid and stabilised site access to reduce the likelihood of sediment being trafficked off site. Sediment control fencing will be installed around the perimeter of the development site as needed.

Detailed Stormwater Plans and Report including DRAINS modelling have been prepared DRB Consulting Engineers provided at Appendix B.

5.4 FLOOD

Whilst the site is not identified as flood prone land within Council's flood planning area, an assessment of potential onsite flood impacts as part of the Timbumburi Creek catchment has been undertaken. The flood impact assessment has been undertaken by Torrent Consulting and has been provided at Appendix G.

The flood modelling results show that at the 1% AEP event (and even the PMF) the proposed solar farm infrastructure is largely unaffected by flooding, being effectively a low flood hazard environment. The flood depths are shallow, and the PV tracker arrays will be elevated well above the flood levels.

Ample flood free refuge is available on site if people are present during a flood event. Due to the nature of the local topography it is also expected that the roads connecting the site will also be largely unaffected by flooding.

The preliminary flood impact assessment indicates that the proposed solar farm development is likely to have only minor localised impacts which are localised to the site and are not expected to adversely impact neighbouring properties. The proposed development is considered to be suitable for the site.

5.5 FLORA AND FAUNA

Kleinfelder have undertaken a Flora and Fauna Assessment of the proposed development (refer Appendix J). This assessment has been undertaken with reference to the EP&A Act 1979 as well as the BC Act 2016 and the EPBC Act 1999.

As noted within the Flora and Fauna Report, the site has been mostly cleared of native vegetation with isolated mature trees. Impacts on biodiversity values have been addressed through an iterative design process to avoid areas of higher biodiversity value within the site. The proposal seeks approval to remove approximately 37 mature trees and large shrubs along with three hollow bearing trees. These trees do not form part of a Threatened Ecological Communities (TEC) and are not considered to be important habitat for the long-term survival of threatened species within the locality.

Field surveys undertaken by qualified ecologist(s) recorded no threatened flora or fauna species on the site with the proposed development 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, ecological communities, migratory species or important habitat for such entities was identified within the subject site. The Flora and Fauna Assessment determined that impacts to Matters of National Environmental Significance are unlikely; therefore, an EPBC referral to the Commonwealth Minister for the Environment is not recommended.

Inclusion of the avoidance and mitigation measures made within the Flora and Fauna Report in relation to erosion and dust control, chemical spills, tree removal, and management of displaced fauna will be followed to reduce potential impacts to biodiversity values within the subject site and the environment.

5.6 NOISE

A Noise Assessment (NA) undertaken by Muller Acoustic Consultants measured and modelled the potential noise generation for the operation (both during construction and once operational) including sleep disturbance noise emissions (refer to Appendix I).

Operational Noise

The results of the NA demonstrate that emissions from the project would satisfy the relevant Project Noise Trigger Levels (PNTL) at all assessed receivers for all assessment periods once the above noise controls are implemented. Furthermore, sleep disturbance is not anticipated, as emissions from impact noise are predicted to remain below the EPA screening criterion for sleep disturbance and awakenings.

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

Construction Noise

Modelled noise emissions from project construction activities identify that relevant noise management levels may be exceeded at two receiver locations. Hence, noise management measures as provided in the enclosed Noise Assessment (refer to Appendix I) are to be implemented to reduce potential impacts on surrounding receivers during construction activities.

Construction noise mitigation measures to be implemented 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.

5.7 LANDSCAPE AND VISUAL IMPACT

Visual Impact

It is relevant to consider the visual impact of the proposal given the existing rural landscape character of the area and location of a number of neighbouring properties within 1km of the site. Mara Consulting has undertaken a Visual Impact Assessment (VIA) to assess the potential visual amenity changes which may occur as a result of the proposed development, see Appendix E.

The proposed development is likely to have a high visual impact from the buildings and residences immediately to the north (one property) and east (two properties) of the proposed development. The visual impact is primarily due to the close proximity. Additionally, the rectilinear forms and rigid linear arrangement of the solar panels contrasts with the surrounding natural forms.

The development is most visible from distance of between 1.5km to 3km and generally from the east due to the sites slope down towards the east. Existing trees provide some visual buffering for the development. The visual impact is low to medium from this distance.

The proposed development is likely to have a low impact on regional views (3km to 6km) as solar arrays will generally blend in with the rooftops or will be screened by vegetation.

To manage visual impacts a range of mitigation measures are proposed. Landscaping is to be established to provide a visual buffer and is to consist of a number of mature trees and shrubs planted along the northern and eastern development site boundaries. If possible, structures are to be coloured a neutral pallet consistent with the surrounding area with bright and contrasting colours avoided. All the proposed panels utilise an anti-reflective coating to minimise potential for glare caused by the solar panels.

Implementation of the mitigation measures as detailed within the VIA will provide an effective visual buffer compatible with the rural landscape of the Westdale and Tamworth areas enhancing the visual amenity for local residents and visitors to the area.

Landscaping

In line with the recommendations of the VIA (Appendix E) Mara Consulting have prepared a Landscape Plan to compliment development at the site (refer Appendix F). The Landscape Plan aims to provide screening of the development from nearby residences and from further afield, perimeter planting is proposed along the northern, eastern and western boundaries.

The planting palette is based mainly on durable native species which enhance the local ecology and compliment the rural character of the surrounding landscape. Large shrubs and small trees will be used along the eastern, western and northern boundaries to screen any potential visual impact the proposal may have when viewed from Country Road or nearby dwellings. Larger tree species are proposed intermittently along the northern boundary to assimilate with the current landscape setting.

5.7.1 GLARE ANALYSIS

A Reflective Glare Assessment (RGA) has been undertaken by SLR Consulting to assess the potential for reflected light induced impacts on aviation, road operations, rail operations, industrial and heavy machinery operations, and residential amenity.

The proposed solar PV panels include solar trackers which results in minimal potential for horizontal reflectivity to occur as light is generally reflected upwards. As a result, impacts on residents, roadway operation, and on any surrounding mechanical operations is considered to be negligible at all times of the year.

A quantitative analysis of the solar glare generated by the proposed development has been undertaken using SGHAT model. The assessment found that under normal operation of the solar farm there will be nil glare potential for Air Traffic Controllers and for runways at Tamworth Airport. A theoretical worst case "Zero Tilt" assessment found potential afterimage along a worst case landing path to Runway 36.

Accordingly, under normal "Operational" mode, the above findings meet the SGHAT requirements recommended by the FAA for off-airport Solar PV installations and would therefore present no hazard to air navigation. To avoid the potential for impact occurrences along Runway 36 for the theoretical "Zero Tilt" scenario, it is recommended that, in any situation where the tilting action of the solar array is disabled, panels should not be left horizontal, but be left tilted to the east, ideally at the maximum 60° tilt angle during the months of September to April.

Glare resulting from onsite lighting will be installed in accordance with AS4282-1997 *Control of the Obtrusive Effect of Outdoor Lighting* effectively controlling potential for light spill and glare generated by the proposed development.

Due to the use of high quality solar tracking systems and site buffer distances to surrounding receivers and transport networks, potential for glare impacts on the surrounding area is considered to be negligible. For further detail and discussion see Appendix L.

5.8 HERITAGE

5.8.1 INDIGENOUS CULTURAL HERITAGE

Virtus Heritage undertook an Aboriginal Archaeological Due Diligence Assessment for the proposed development area in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (2010) and where applicable, the requirements of the *Code of Practice for Archaeological Investigation of Aboriginal Objects, NSW* (2010). See Appendix H for further discussion.

A site survey was undertaken with a member of the Tamworth Local Aboriginal Land Council (LALC), Mr Christopher 'Donny' Fermor. During the site survey, one potential scarred tree was located during the survey. Further to this, Mr Fermor noted that the area is not likely to contain campsites and is more likely a transitory area for moving between resource zones and hunting.

The cultural status of the scarred tree has not been fully confirmed by an arboriculturalist with the design of the proposed development still including the tree within the development envelope. An arboriculturalist is currently assessing the potential scar tree with detail to be provided to Council once received.

To ensure the protection of any found Aboriginal artefacts during construction, all site workers and personnel involved in works are to 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 additional unknown objects or items are uncovered during excavation. Further procedures and protocols are to be established as part of any future Construction Management Plan.

5.9 SOCIAL AND ECONOMIC IMPACTS

An analysis of the social and economic impacts associated with the development of the site is detailed within a Social Impact Statement (SIS) undertaken by Mara Consulting provided in Appendix K. The SIS includes consideration of:

+ The social baseline of Westdale State Suburb, as well as the wider Tamworth Regional LGA;
+ Assessment of the likely social impacts of the proposed development based on the scale, intensity and duration of the potential impacts;

- Proposed mitigation and enhancement strategies of impacts that may have a potentially significant impact on the community; and
- Conclusions and recommendations that arise from the assessment in relation to the project.

A review utilising existing renewable projects along with NSW State Government research reveals support of renewable energy projects is generally favourable with the North West Region which includes the broader Tamworth region revealing:

- 94 per cent of respondents supported using renewables to generate electricity in NSW;
- 81 per cent believed NSW should increase the use of renewables over the next five years; and
- 95 per cent supported the use of solar farms in NSW, 92 per cent in their local region, and 84 per cent within 1–2 kilometres of where they lived.

The most common perceived advantages of renewables included environmental benefits and lower cost of electricity. The most common perceived disadvantages included higher cost and concerns about efficiency and reliability. In the North West, 74 per cent were prepared to use renewables 'provided I don't have to pay more for my electricity' and 22 per cent were prepared to pay more to support them.

The SIS found that the project will improve intergenerational equity through its beneficial contribution to Australia's Climate Change and greenhouse gas minimisation efforts, specifically:

- Directly contribute to helping Australia in meeting the Renewable Energy Target;
- Reduce greenhouse gas emissions required to meet Australia's international climate conditions; and
- Assist in the transition towards cleaner electricity generation.

This is achieved by the solar farms potential to generate up to 5MW of electricity potentially powering 2,000 homes during daylight hours whilst reducing CO_2 emissions by around 200,000 tonnes over the lifespan of the project.

Ongoing communication with the community has been highlighted as an imperative to maximise social benefits of the proposed development. Further recommendations include the following:

- Liaison with local industry representatives to maximise the use of local contractors, manufacturing facilities, materials;
- Establish visual screening early to minimise the visual impact on the solar farm. Visual screening should be done in consultation with closest property holders in accordance with Visual Impact Assessment and Landscaping Plan;
- Establish good relations with people living in the vicinity of the proposal site at the beginning of the proposal and maintain; and
- Implement a community consultation plan to manage impacts to community stakeholders, including but not limited to:
    - mitigation measures to reduce potential construction impacts
    - protocols to keep the community updated about the progress of the Proposal and proposal benefits
    - protocols to inform relevant stakeholders of potential impacts (haulage, noise, air quality etc.)
    - protocols to respond to any complaints received

- information on how potential customers can access the renewable energy source
- a process to monitor the predicted social impacts and amend mitigation and management measures as required.

In summary, the proposed establishment of a Solar PV Farm on the site is anticipated to have an ongoing positive social and economic impact on the local Westdale area and the broader Tamworth community. Overall, it is considered that the development:

+ Is consistent with the regulatory and business development framework, including state government legislation and the Tamworth Regional Council strategic plans;
+ Will have positive impacts intergenerational equity, with the provision of cleaner energy in the future;
+ Supports Commonwealth and NSW climate change commitments;
+ Will generate enough clean, renewable energy for about 2,000 homes;
+ Is an appropriate development in relation to the projected changes to population and demographics in the region;
+ Is unlikely to have significant negative social impacts to the locality and region; and
+ Would be a benefit contributing to the overall community sustainability of the Tamworth community.

5.9.1 COMMUNITY CONSULTATION

PAG has undertaken consultation with surrounding land owners likely to be impacted by the proposed development. This process includes the use of letterbox drops, face-to-face meetings, and phone calls to establish the land owners concerns regarding the project. Liaison with Council have occurred including a Pre-DA meeting with Council staff discussed in Section 1.1.

6 CONCLUSION

The proposed solar PV electrical generation operation located at part Lot 211 in DP 1069964, Country Road, Westdale will provide electrical power to support the needs of Tamworth and the surrounding agricultural operations along with rural towns and villages. With the growth of the Tamworth area, the new electrical generator proposed under this DA will greatly assist in meeting the growing electrical demands required to support that growth.

The site has been chosen for its suitability in terms of land use zoning, relatively flat topography, limited trees and vegetation, distance to surrounding residents, and access to high capacity transmission lines.

The proposed solar PV electrical generation plant is permissible with consent within the RU4 Primary Production Small Lots zone, under the Tamworth Regional LEP 2010. The proposed development will meet the objectives of the RU4 zone as it will provide a rural compatible land use which will support rural centres and agricultural operations through the provision of power generation. The development will not generate inappropriate traffic on Country Road nor will it generate inappropriate noise or dust. The development is compliant with the relevant LEP clauses and the requirements of the DCP 2010, presenting no variations to any development standard or development controls.

The ongoing operation will not adversely impact on the efficiency and effectiveness of the local and state road network. High-quality landscaping including native trees and shrubs along site boundaries will provide an effective visual buffer compatible with the rural landscape of the Westdale area.

The design of the development incorporates appropriate stormwater management, respects the natural environment, and minimises potential amenity impacts on neighbouring properties.

Due to the use of high quality solar tracking systems and site buffer distances to surrounding receivers and transport networks, potential for glare impacts on the surrounding area is considered to be negligible.

In summary, this SEE has addressed the potential impacts arising from the proposal including traffic, access and parking, noise, visual amenity, ecological, glare, heritage and waste and water management. Where necessary, mitigation measures are proposed to minimise these potential impacts and reduce potential risk associated with the development.

Given the merit of the design and the absence of any significant adverse environmental impacts or planning issues, the DA is considered to be in the public's interest and worthy of Council's support.

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APPENDIX A – ARCHITECTURAL PLANS

RINA Consulting

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APPENDIX B – STORMWATER MANAGEMENT PLAN

DRB Consulting Engineers Pty Ltd

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APPENDIX C – COMPLIANCE TABLES

KDC Pty Ltd

Table 2 – Tamworth Regional DCP 2010 Compliance

Control	Requirement	Comment	Compliant
Step 3: General Development			
Other Types of Development			
Parking	• Parking must be provided as per the Schedule in Appendix 1. • Where calculation of parking spaces required results in a fraction of a space, the total required number of spaces will be the next highest whole number. • Parking and traffic requirements will be based on consideration of: o likely peak usage times; o the availability of public transport; o likely demand for off street parking generated by the development; o existing traffic volumes on the surrounding street network; and o efficiency of existing parking provision in the location. • Comply with AS2890.1 Parking Facilities Off Street Car Parking and AS2890.6 Parking Facilities Off Street Parking for People with a Disability • Manoeuvring areas within the development must be designed to accommodate a B99 vehicle under AS2890.1 Parking Facilities Off Street Parking. • Where existing premises are being redeveloped or their use changed, the following method of calculation shall apply:- (a) Determine the parking requirements of the previous or existing premises in accordance with any existing development consent. Otherwise the rate contained in Appendix A should be applied. (b) Determine the parking requirement of the proposed development in accordance with Appendix A; (c) Subtract the number of spaces determined in (a) from the number of spaces calculated in (b); (d) The difference calculated in (c) represents the total number of parking spaces to be provided either in addition to the existing on-site carparking or as a cash-in-lieu contribution to Council where applicable.	The proposed solar PV site has no applicable parking rate within Appendix 1 or the RTA Guide to Traffic Generating Development. The site has sufficient space to facilitate onsite parking for both the construction and operational phases of the development. The driveway is to comply with AS2890 with all vehicles able to enter and exit the site in a forward direction.	Yes

Landscaping	• Location and grouping of plant types shall be multi-functional providing privacy, security, shading and recreation functions. • Landscaping or shade structures shall be provided in outdoor car parking areas where >10 spaces are required, to provide shading and soften the visual impact of large hard surfaces. • Landscaping shall comprise low maintenance, drought and frost tolerant species.	Landscaping is proposed where necessary to minimise visual impact on the rural landscape. A landscape plan prepared by Mara Consultant has been provided at Appendix F.	Yes
Outdoor Lighting	• All developments shall demonstrate compliance with AS4282 Control of Obtrusive Effects of Outdoor Lighting. • Sweeping lasers or searchlights or similar high intensity light for outdoor advertising or entertainment, when projected above the horizontal is prohibited. • Illuminated advertising signs should be extinguished outside of operating hours, or 11pm, whichever is earlier.	Any outdoor lighting will be designed in accordance with AS4282. The lighting will not be high intensity and will not be for lasers, searchlight or for advertisement.	Yes
Environmental Controls			
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: o Traffic o Flood liability o Slope o Construction impacts o Solid and Liquid Waste o Air quality (odour and pollution) o Noise emissions o Water quality o Sustainability	A range of assessment reports have been provided in support of the proposed development. These include traffic, visual impact, flood, acoustic, ecological, Aboriginal cultural heritage, social impact. Further comments have been provided for glare impacts, dust, water management.	Yes
Soil and Erosion Control	• Runoff shall be managed to prevent any land degradation including offsite sedimentation. • Reference shall be made to the NSW Governments Managing urban stormwater: soils and construction, Volume 1 (available from Landcom), commonly referred to as "The Blue Book". • Cut and fill will be minimised and the site stabilised during and after construction. • Arrangements in place to prompt revegetation of earthworks to minimise erosion.	An erosion and sediment control plan governing the construction phase of the development has been provided within the civil plans at Appendix B.	Yes
Vegetation	• Development design shall accommodate the retention of any significant trees and vegetation.	The development area is largely cleared agricultural land and as a result a total of 37 trees and shrubs are required to be removed.	Yes
Waste Management	• General waste storage and collection arrangements shall be specified	Minimal waste will be generated by the development. The majority of the construction phase consists of the erection of pre-fabricated solar units. A Waste Management Plan has been provided at Appendix M.	Yes

Step 5: Discretionary Development Standards			
Environmental Standards			
1.44 Vegetation	a) Existing trees may be removed from the proposed building footprint where it can be shown there is no acceptable alternative design. b) All trees removed must be replaced by comparable native and mature trees. c) Non-native plants may be used where they are shown to be non-invasive and pivotal to the overall amenity of the development.	37 trees and shrubs are proposed to be removed to facilitate the proposed development. Appropriate landscaping is proposed to manage tree removal and visual impact. N/A, no non-native plants species proposed.	Y Y N/A

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APPENDIX D – TRAFFIC IMPACT ASSESSMENT

Intersect Traffic

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APPENDIX E – VISUAL IMPACT

Mara Consulting

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APPENDIX F – LANDSCAPE PLAN

Mara Consulting

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APPENDIX G – FLOOD IMPACT ASSESSMENT

Torrent Consulting

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APPENDIX H – ABORIGINAL DUE DILIGENCE ASSESSMENT

Heritage Now

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APPENDIX I – NOISE ASSESSMENT

Muller Acoustic Consulting

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APPENDIX J – ECOLOGICAL ASSESSMENT REPORT

Anderson Environment & Planning

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APPENDIX K – SOCIAL IMPACT STATEMENT

Mara Consulting

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APPENDIX L – REFLECTIVITY GLARE ASSESSMENT

SLR Consulting

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APPENDIX M – WASTE MANAGEMENT PLAN

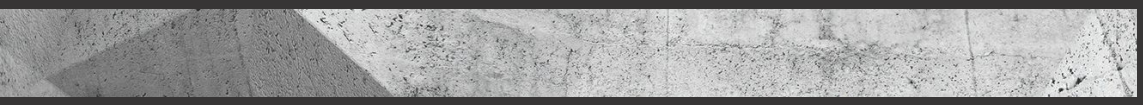
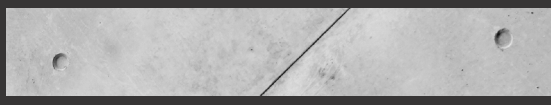
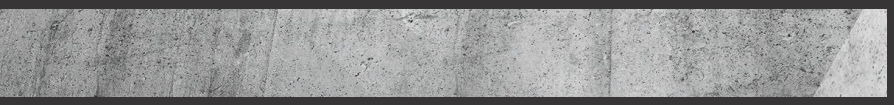
KDC Pty Ltd

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APPENDIX N – CAPITAL INVESTMENT VALUE REPORT

RPS Group

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Noise Assessment

South Tamworth Solar Farm
Tamworth, NSW

Prepared for: KDC Pty Ltd
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Muller Acoustic Consulting

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Noise Assessment

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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) on behalf of Providence Asset Group (PAG) for the proposed South Tamworth Solar Farm near Tamworth, 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 Tamworth Regional Council 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

PAG propose to construct and operate a 5 Megawatt (MW) solar farm using photovoltaic (PV) technology at Country Lane, Westdale, NSW approximately 4km south west of Tamworth, NSW.

2.2 Description of Proposed Construction Works

The project includes installation of groups of north facing PV modules (approximately 2m x 1m) on mounting structures of approximately 1.5m in height. An estimated 14,000 PV panels will be installed using a single axis tracking system, tilting along the north-south axis. The PV mounting structure would comprise steel posts driven 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..

Where cabling of each PV array/module to inverters is required to be underground, earthworks will primarily involve trenching. 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 six month period during standard construction hours.

All vehicles would access the project via Country Lane during construction and operational phases.

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 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 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 6m spacing between each row. The hub height of each tracker is 1.5m with the peak of the modules reaching a height of 2.3m 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 the adjacent existing powerline. 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 (GDA94/MGA56)	
			Easting	Northing
R1	236 Green Street	Residential	296408	6556372
R2	115 Country Road	Residential	296612	6557243
R3	New Winton Road	Residential	297266	6556278
R4	194 Country Road	Residential	296663	6556575
R5	216 Country Road	Residential	296274	6556626
R6	Oxley Lane	Residential	296104	6556178
R7	18-50 Mayne Drive	Residential	296117	6555848
R8	236 Gunnedah Road	Residential	295858	6555471
R9	New Winton Road	Residential	296278	6556884
C1	Proposed RFS Control Centre	Commercial	297443	6557106
I1	Baiada Chickens	Industrial	297253	6557330

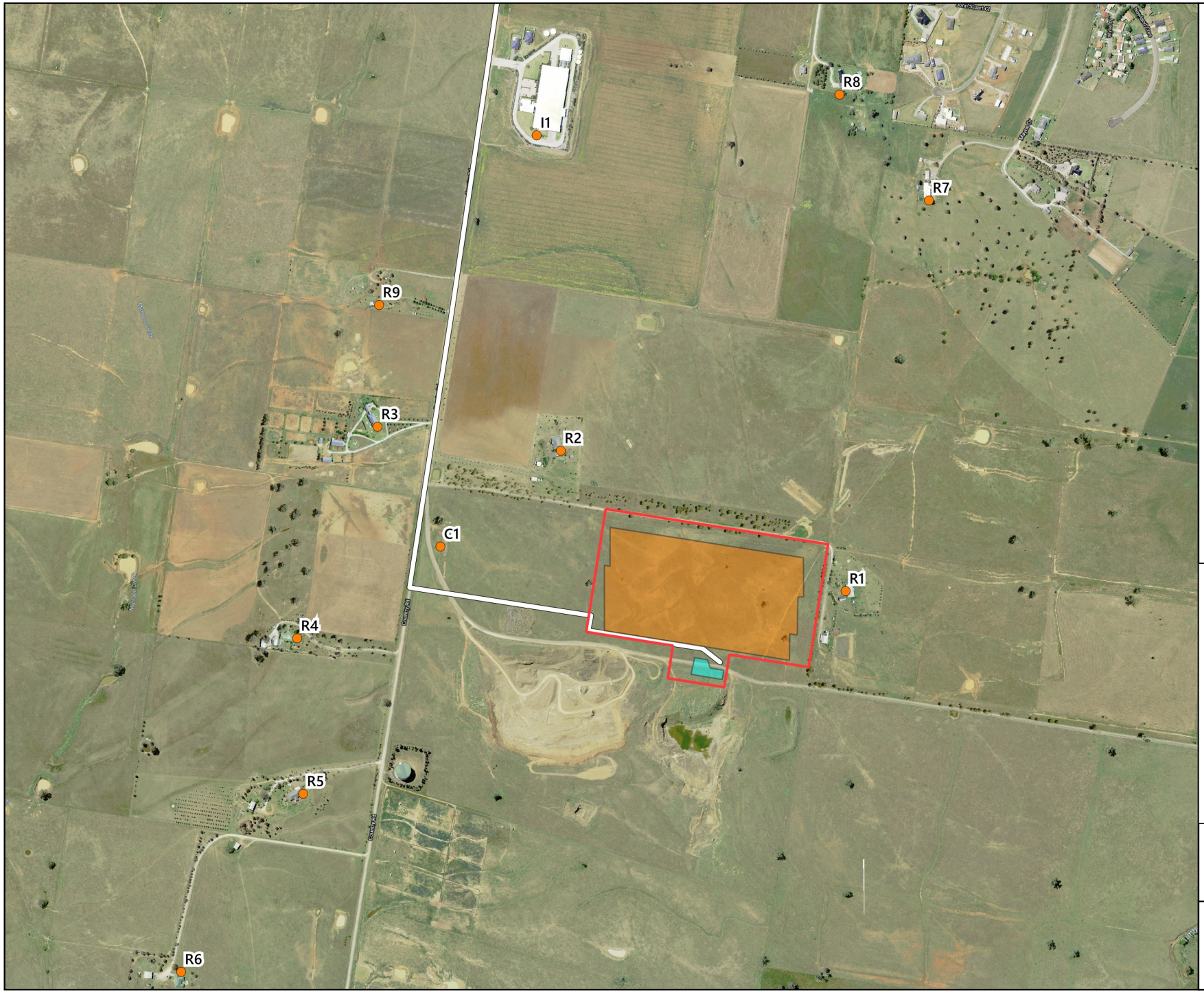


FIGURE 1

PROJECT LAYOUT

MAC190968-03

South Tamworth Solar Farm

KEY

- Receivers
- Access Route
- Panel Array
- Construction Compound
- Project Boundary

0 100 200 300 400 m

N

MAC
Muller Acoustic Consulting

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; and
- NSW Department of Environment, Climate Change and Water (DECCW), NSW Road Noise Policy (RNP), 2011.

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 Standard Hours for Construction

Period	Preferred Construction Hours
Day (Standard construction hours)	Monday to Friday - 7am to 6pm Saturdays - 8am to 1pm Sundays or Public Holidays - No construction

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 $LA_{eq(15min)}$ NMLs and how they are to be applied.

Table 3 Noise Management Levels

Time of Day	Management Level $LA_{eq(15min)}$[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. For guidance on negotiating agreements see section 7.2.2.
Commercial	70dBA	Offices, retail outlets
Industrial	75dBA	Industrial premises

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 adopted RBLs relevant to the project are contained in **Section 4.1**.

3.2.3 Project Intrusiveness Noise Level (PINL)

The PINL ($LA_{eq(15min)}$) is the RBL + 5dB and seeks to limit the degree of change a new noise source introduces to an existing environment. Hence, when assessing intrusiveness, background noise levels need to be measured.

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 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.

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
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 Level Assessment

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:

- $L_{Aeq(15min)}$ 40dB or the prevailing RBL plus 5dBA, whichever is the greater, and/or
- L_{Amax} 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 4.4.

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4 Noise Assessment Criteria

Background noise monitoring has not been conducted for this project and hence, the minimum applicable Rating Background Levels (RBL) 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 $L_{Aeq(15min)}$ (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, dB $L_{A90(period)}$	NML dB $L_{Aeq(15min)}$
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)
Commercial	All Periods	N/A	65
Industrial	All Periods	N/A	70

Note 1: See Table 2 of this report for Recommended Standard Hours for Construction.

4.2 Construction Vibration

Department of Environment and Conservation (DEC) 2006, Assessing Vibration: A Technical Guideline (the 'Guideline') provides guidance on determining effects of vibration on buildings occupants. The guideline does not address vibration induced damage to structures, blast induced vibration effects or structure borne noise effects.

A qualitative assessment of potential vibration impacts has been completed. Due to the nature of the works proposed and distances to potential vibration sensitive receivers, vibration impacts from the project would be negligible.

The Construction Noise Strategy (Transport for NSW, 2018) sets out safe working distances to achieve the human response criteria for vibration. The key vibration generating sources proposed to be used are a small pile driver for panel mounts and a vibratory roller used for road construction. For a large vibratory roller, the Construction Noise Strategy sets a safe working distance of 25m to achieve the residential human response criteria for continuous vibration. Therefore, as the nearest receivers to the project are greater than 25m, human exposure to vibration is anticipated to be minimal. Furthermore, where the human response criteria are satisfied, the structural or cosmetic criteria for sensitive receivers will be achieved.

Therefore, vibration impacts are not considered to be a significant issue and have not been considered further in this assessment.

4.3 Operational Noise Criteria

4.3.1 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(period)	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.

4.3.2 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
Commercial		When in use	65	60	63
Industrial		When in use	70	65	68

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 15-minute assessment period as per Section 2.2 of the NPI.

4.3.3 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 $L_{Aeq(15min)}$ 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 Receivers (Rural)	Day	40	53	40
	Evening	35	48	35
	Night	35	43	35
Commercial	When in use	--	63	63
Industrial	When in use	--	68	68

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.

4.3.4 Maximum Noise Trigger Levels

The maximum noise trigger levels shown in **Table 9** are based on night time RBLs and trigger values as per Section 2.5 of the NPI.

Table 9 Maximum Noise Trigger Levels

Residential Receivers			
dB LAeq(15min)		dB 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: As per Section 2.5 of the NPI, the highest of the two criteria are adopted as the trigger level.

4.4 Road Traffic Noise Criteria

The road traffic noise criteria are provided in the RNP. For this assessment, the 'sub arterial road' category for Country Lane has been adopted. It is acknowledged that the functional classification of Country Lane 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)
Arterial Roads Sub Arterial Roads	Country Lane	Existing residences affected by additional traffic on existing arterial roads generated by land use developments	60dB LAeq(15hr) external	55dB LAeq(9hr) 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.

5 Noise Assessment Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers for typical construction activities and operations. DGMR (iNoise, Version 2020.0) noise modelling software was used to quantify noise 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 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 four construction scenarios have the potential to occur simultaneously at up to two key 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	204	78	84
2.5MW Inverter[2]	Constant	2	81	84
5MVA Transformer[2]	Constant	1	77	77

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, Noise Enhancing Meteorological Conditions as per Table D1 of the NPI have been adopted in the noise modelling assessment and are summarised in **Table 13**.

Table 13 Modelled Site Specific Meteorological Parameters – Noise Enhancing Meteorological Condition				
Assessment Condition[1]	Temperature	Wind Speed / Direction	Relative Humidity	Stability Class
Day	20°C	3m/s all directions	50%	D
Evening	10°C	3m/s all directions	50%	D
Night	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.

6 Noise Assessment Results

6.1 Construction Noise Results

Noise levels were predicted to each assessed receptor assuming receiver heights of 1.5m above ground level for typical construction activities for standard construction hours. **Table 14** summarises the predicted noise level range and maximum predicted noise level for each of the construction scenarios (trenching, piling and assembly) at identified residential receivers.

Noise levels at two receivers are expected to exceed the NMLs when works are at their nearest proximity. The exceedance would be temporary, of short duration and is primarily due to piling activities.

Table 14 Predicted Construction Noise Levels

Receiver ID	Description/Address	Predicted Noise Level Range dB $L_{Aeq(15min)}$[1]	Highest Predicted Noise Level dB $L_{Aeq(15min)}$	NML Standard Hours dB $L_{Aeq(15min)}$	Compliance Achieved
R1	236 Green Street	39-61	61	45	No
R2	115 Country Road	34-55	55	45	No
R3	New Winton Road	23-44	44	45	Yes
R4	194 Country Road	21-42	42	45	Yes
R5	216 Country Road	20-41	41	45	Yes
R6	Oxley Lane	20-36	36	45	Yes
R7	18-50 Mayne Drive	24-44	44	45	Yes
R8	236 Gunnedah Road	22-42	42	45	Yes
R9	New Winton Road	21-41	41	45	Yes
C1	Proposed RFS Control Centre	27-48	48	65	Yes
I1	Baiada Chickens	20-40	40	70	Yes

Note 1: Noise levels from construction activities vary due to their position across the project site with respect to surrounding receivers.

6.2 Operational Noise Results

Noise levels were predicted at each assessed receiver assuming heights of 1.5m above ground level during the night time for noise enhancing meteorological conditions as described in Table 13. 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 - Noise Enhancing Meteorological Conditions

Receiver ID	Description/Address	Predicted Noise Level dB $L_{Aeq(15min)}$	Limiting Night PNTL dB $L_{Aeq(15min)}$	Compliance Achieved
R1	236 Green Street	<30	35	Yes
R2	115 Country Road	<30	35	Yes
R3	New Winton Road	<30	35	Yes
R4	194 Country Road	<30	35	Yes
R5	216 Country Road	<30	35	Yes
R6	Oxley Lane	<30	35	Yes
R7	18-50 Mayne Drive	<30	35	Yes
R8	236 Gunnedah Road	<30	35	Yes
R9	New Winton Road	<30	35	Yes
C1	Proposed RFS Control Centre	<30	63	Yes
I1	Baiada Chickens	<30	68	Yes

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.

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 screening criterion of 40dB $L_{Aeq(15min)}$ and there are no operational noise sources that generate significant maximum noise events.

6.4 Road Traffic Noise Assessment

The major transport route for all vehicles to the access the project site would be via Country Lane from the Oxley Highway. During construction, traffic generated by the project include 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 the closest receiver on Country Lane, 110m from the road centre has been completed. The calculation has been completed using the United States (US) Environment Protection Agency's road traffic calculation method and results are presented in **Table 16**.

Table 16 Predicted Construction Road Traffic Noise Levels

Road Name	Offset Distance to Receiver	Predicted Noise Level	RTN Criteria	Compliance Achieved
Country Lane	110m	40dB LAeq(15hr)	60dB 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 anticipated to exceed the relevant NMLs depending on the type of construction and proximity of activities to receivers. Recommendations for consideration during the construction phase 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;
- minimise 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.

7.2 Operational Noise Recommendations

Operational noise predictions identify that relevant noise criteria would be satisfied at all receivers. Notwithstanding, it is recommended that the proponent actively minimise potential noise emissions from the project. To assist in noise management for the project it is recommended that a one-off noise validation monitoring assessment be completed to quantify emissions from site and to confirm emissions meet relevant criteria.

8 Discussion and Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has been engaged by KDC Pty Ltd (KDC) to complete a Noise Assessment (NA) for the proposed South Tamworth Solar Farm, near Tamworth, 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 two receiver locations. Recommendations have been provided to minimise the potential noise impacts from construction, albeit of a temporary nature during the daytime over a six month construction period.

Operational noise levels satisfy the NPI PNTLs for assessed receivers. However, recommendations to ensure noise levels are verified have been provided in this report.

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

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

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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

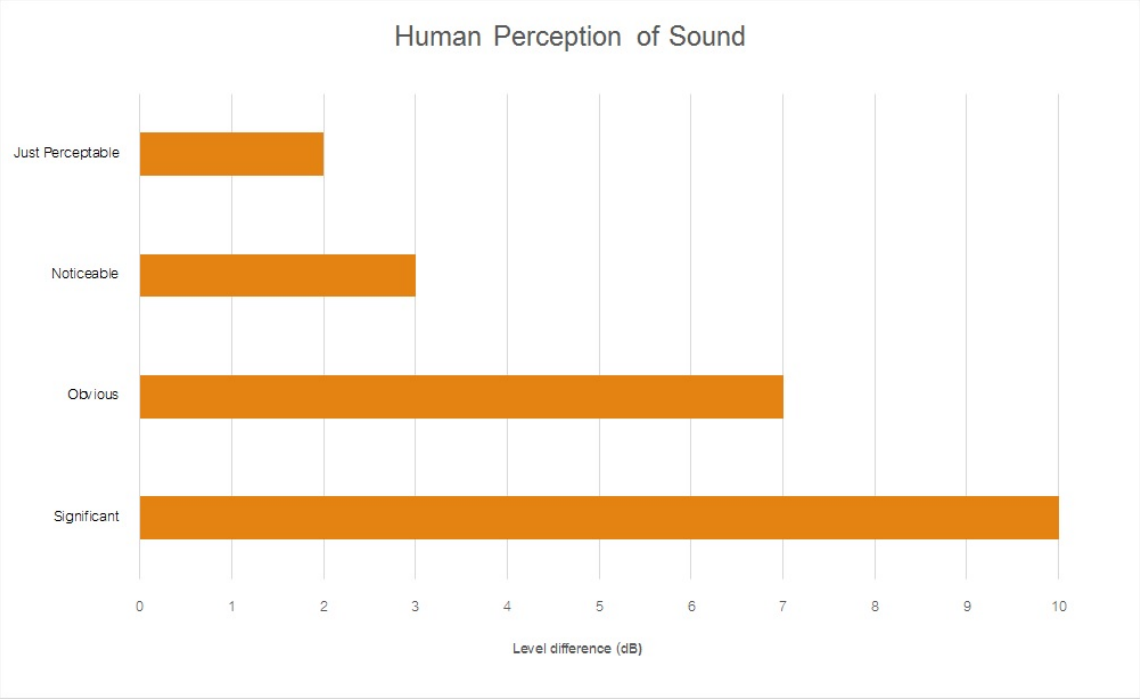
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 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.
Extraneous Noise	Noise resulting from activities that are not typical of the area. Atypical activities include sources such as construction and holiday period traffic.
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,T	The summation of noise over a time period, T. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAmax	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.log10 (W/Wo) Where: W is the sound power in watts and Wo 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 Pressure 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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VIRTUSHERITAGE



South Tamworth Solar Project
Country Road
Westdale, NSW

DUE DILIGENCE ABORIGINAL ARCHAEOLOGICAL ASSESSMENT
FINAL ♦ April 2020

Prepared for KDC on behalf of Providence Asset Group

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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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Appendix A Comments from Aboriginal Parties (*to be included when received*)

Appendix B National Native Title Tribunal Search results

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EXECUTIVE SUMMARY

Virtus Heritage was engaged by KDC on behalf of Providence Asset Group to prepare an Aboriginal archaeological due diligence assessment for the South Tamworth Solar Farm Project. The site is located at Westdale, NSW, within the Tamworth Regional Council Local Government Area (LGA). Proposed works include the development of a solar farm operating at no larger than 5MW. The proposal includes a grid-connected solar PV installation which will feed into the electrical transmission grid via existing transmission lines running along the northern boundary of the project area.

Consultation

The project area lies within the boundaries of the Tamworth Local Aboriginal Land Council (LALC). Mr Christopher 'Donny' Fermor, Tamworth LALC, Sites Officer, 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 this draft report was provided to the LALC for review and comment (refer to **Appendix A**).

Environmental Context

The project area and wider region would have provided ample terrestrial floral and faunal resources for Aboriginal people in the past and the Peel River and connecting creeks, including Timbumburi Creek, approximately one kilometre from the project area, would have been a rich source of aquatic animals. 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.

The previous land use history indicates that the project area has been subject to heavy land degradation, which is highly likely to have impacted the retention of any remnant or later topsoils. The combination of farming and quarrying in the project area renders the preservation of intact Aboriginal sites and material culture unlikely.

Archaeological Context

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.

Site Inspection Results

A site inspection was undertaken by Elle Lillis, Senior Archaeologist, Virtus Heritage and Mr Christopher 'Donny' Fermor on 5 March over one field day. The proposal area was surveyed by pedestrian targeted survey, all areas of exposure, mature trees and drainage lines were inspected. Due to recent rain causing dense vegetation growth, exposures and visibility were poor across the proposal area. Where visible, topsoils were largely disturbed due to European land use such as clearing, stock damage, modification for dam and contour bank construction, sheet was erosion on slopes and gullying erosion in vehicle tracks and, in the south of the proposal area, quarrying activity. Soils, where visible, were red clays with high angular gravel content and occasional sub-rounded cobbles.

One potential scarred tree, TQS-ST1, was located during the survey (refer to **Section 5**) which may require further assessment by an aboriculturalist.

During the survey, Mr Fermor commented that the area is not likely to contain campsites, and is more likely a transitory area for moving between resource zones and hunting. Mr Fermor indicated that if grading or slope profiling was required that a LALC sites officer should be given the opportunity to undertake community collection during ground disturbing works up to 200mm.

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) One potential Aboriginal scarred tree was identified as part of this project (TQS-ST1). The design of the proposal should avoid this area.
    a. If this tree cannot be avoided, it is recommended that a qualified aboriculturalist should assess the tree to identify and assess whether the scarring is cultural or natural, or a result of some other non-cultural process (e.g. vehicle impact) in consultation with relevant Aboriginal parties (Tamworth LALC) and the DPIE.

    b. If the scarring on the tree is determined to be cultural, and impact cannot be avoided as part of the project, then following the provisions of the NPW Act, 1974, further impact and significance assessment is required as it would then be deemed and Aboriginal object and require an Aboriginal Cultural Heritage Assessment (ACHA) (with an Archaeological Survey report) in consultation with relevant Aboriginal parties following the DPIE's *Aboriginal Cultural Heritage Consultation Requirements for proponents* (DECCW, 2010).

2) Mr Fermor commented that where any grading or slope profiling works were occurring in the project area that he would like a Tamworth LALC Sites Officer to be given the opportunity to inspect any excavated material up to 200mm depth. Mr Fermor also commented that the area would not have been used as a campsite, but was a transitory area used while travelling or hunting. Tamworth LALC also commented that Mr Fermor or another Sites Officer be on site when work commences. Providence Asset Group may consider this request, however cultural collection can only occur legally in consultation with the DPIE and relevant Aboriginal stakeholder groups as conditioned within an AHIP.

3) AHIMS site records would be prepared and submitted to DPIE AHIMS for the potential scarred tree, TQS-ST1.

4) 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 additional unknown objects or items are uncovered during excavation.
    a. As part of this induction, the contact telephone numbers of the DPIE 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 the location of the Aboriginal sites within the proposal site 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. Providence Asset Group or delegated authority may wish to consider the input and engagement of interested Aboriginal stakeholder groups and Tamworth LALC in the development of inductions and tool box talks for this project.

1. INTRODUCTION

Virtus Heritage was engaged by KDC on behalf of Providence Asset Group to prepare an Aboriginal archaeological due diligence assessment for the South Tamworth Solar Farm project. The project area is located on the eastern side of Country Road, within the Tamworth Regional Council Local Government Area (LGA) (refer to **Figure 1**). The surrounding area is made up of large rural lots generally containing a rural type land use typically with a single dwelling house. The Tamworth Airport is located approximately 2.29km to the north west of the site.

The land is legally known as Lot 211 DP1069964 and is generally referred to as Country Road, Westdale NSW 2340. It consists of a large rural type lot which contains a quarry development covering the central and southern parts of the site. A low number of scattered trees are present on the site, which consists predominantly of low grassland outside of the quarry area. The lot is generally regularly shaped with a separate lot forming the south western corner. The area of the proposed solar PV farm is identified in **Figure 1** below. Access to the existing quarry is provided via a crossover from Country Road located at the north western corner of the lot.

1.1 Project Description

The proposed project is for the development of a solar PV farm at Westdale, which includes a grid-connected solar PV installation operating at no larger than 5MW. It is proposed to connect into the electrical transmission grid via the existing transmission lines which run along the northern boundary of the site. The solar PV farm will include the following components:

- 14,196 x 425w Solar PV panel;
- 204 x Single Axis Solar Trackers;
- 2 x 2,500kVA Inverters; and
- 1 x Medium Voltage Power Station.

A 4m wide access road is proposed connecting the solar farm to the approved access to Country Road at the northern area of the lot. The solar farm will be fully fenced with a gate for access in the north west corner. A car park area, off load area and temporary construction office are indicatively located on the Concept Plan (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 OEH 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 the Environmental Protection and Regulation Division (EPRD) of OEH. 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 Tamworth Local Aboriginal Land Council (LALC).

A copy of this draft report was provided to Tamworth LALC for comment and review. All comments are appended in full for the final report (refer to **Appendix A**). Tamworth LALC agreed with Mr. Fermor's comments made during fieldwork (refer to **Section 5.1.2**) and recommended that Mr. Fermor or another Sites Officer be on the ground when further work commences on the site.

1.4 Limitations

This report is limited to the assessment of project impacts described in information provided by KDC on behalf of Providence Asset Group and mapped in this report. Virtus Heritage takes no responsibility for errors within Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management Systems (AHIMS) data, and the Heritage Branch, NSW listings and has assumed information provided by OEH 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 Elle Lillis (Master of Archaeological Science, Australian National University; B.Arts, University of Newcastle) with assistance from Elaine Lin (M.Arch.Sci (Adv). Hons., Australian National University; B.Arts Hons. Archaeology, The University of Sydney) with quality review undertaken by Dr Mary-Jean Sutton (PhD, Archaeology, University of Queensland; B.Arts, Hon.s. Prehistoric and Historical Archaeology, University of Sydney). Project information and description of works was provided by KDC on behalf of Providence Asset Group.

1.6 Acknowledgements

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

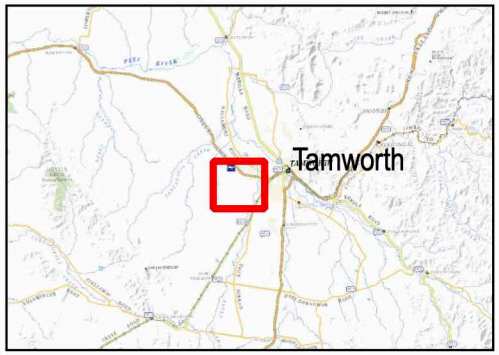
- Donny Fermor, Sites Officer, Tamworth Local Aboriginal Land Council; and
- Rosie Turner, Town Planner, KDC.

VIRTUSHERITAGE

Figure 1
Locality Plan and Project Area

Legend

- Project Area
- Lot
- Drainage Line



Source: NSWSpatial Services Projection: GDA94 MGA zone 56

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.

293000 294000 295000 296000 297000 298000 299000

6559000 6558000 6557000 6556000 6555000 6554000

Airport

Gunnedah Rd

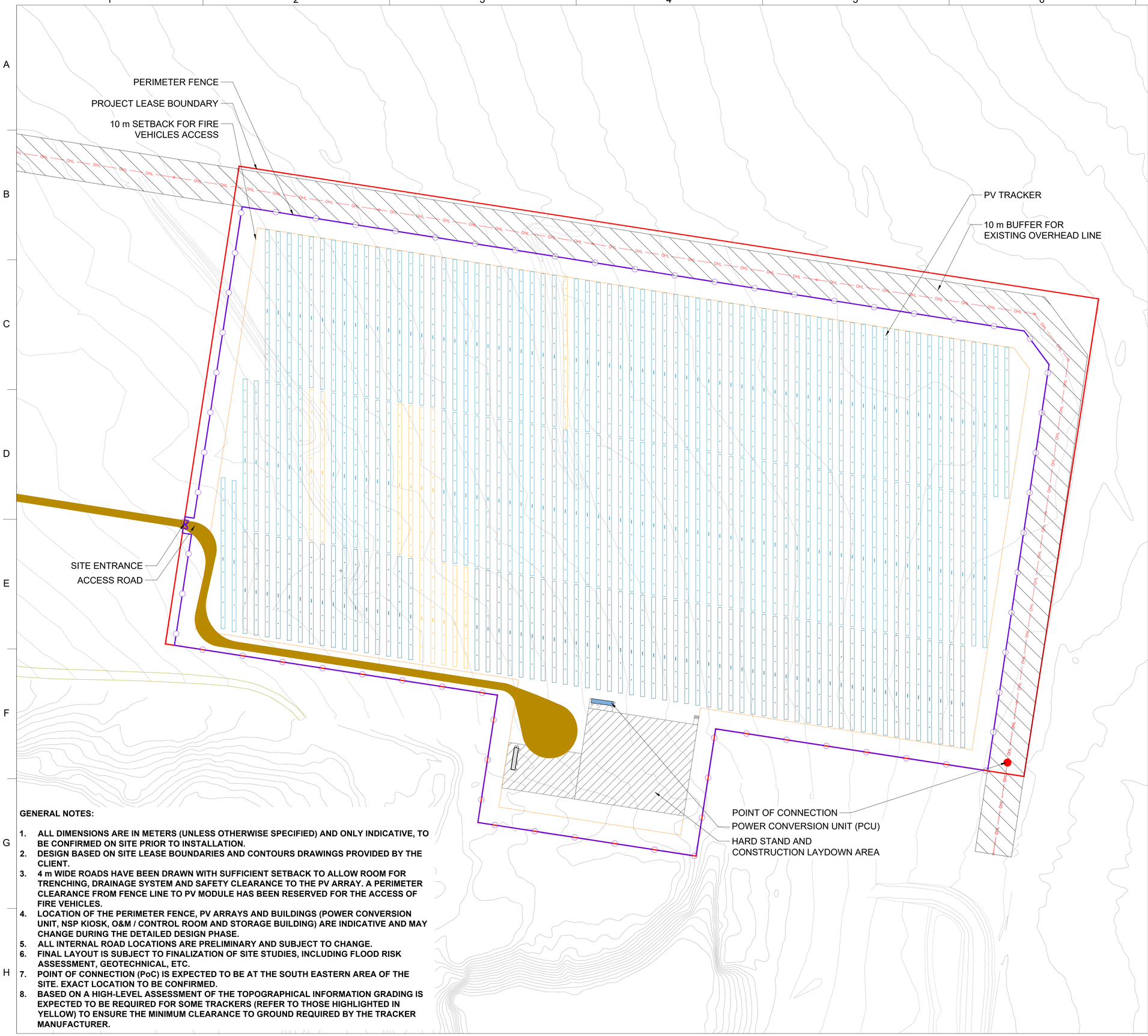
TIMBUMBURI CREEK

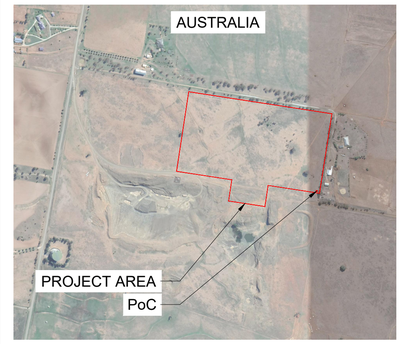
County Rd

Duri Rd

N

0 1 2 3 4 km





LOCATION MAP - SCALE: 1:1,000,000

LEGEND

- PROJECT LEASE BOUNDARY
- EXISTING CONTOUR LINE
- PERIMETER FENCE
- PROPOSED ACCESS/MAINTENANCE ROAD
- HARD STAND AND CONSTRUCTION LAYDOWN AREA
- EXISTING OVERHEAD LINE
- PROPOSED GATE
- POWER CONVERSION UNIT (PCU)
- NETWORK SERVICE PROVIDER (NSP) KIOSK
- O&M BUILDING / CONTROL ROOM AND STORAGE
- PROPOSED PV TRACKER - 1P78 (3 STRINGS)
- PROPOSED PV TRACKER - 1P52 (2 STRINGS)
- PV TRACKER WITH GRADING REQUIRED

SYSTEM SUMMARY

ELECTRICAL CONFIGURATION:

TOTAL PV PLANT CAPACITY (DC): 6,033.3 kWp

TOTAL INVERTER CAPACITY (AC): 5,000.00 kVA (@35C)

PV PLANT MAXIMUM EXPORT CAPACITY (AC): 4,990.00 kVA

DC:AC RATIO: 1.21:1 (REFERRED TO MAXIMUM EXPORT CAPACITY)

STRINGS OF 26 MODULES

273 STRINGS PER INVERTER

PV MODULES:

MFR:	RISEN SOLAR TECHNOLOGY
MODEL:	JAGER PLUS RSM156-6-425M
NAMEPLATE:	425Wp
QUANTITY:	14,196

INVERTERS:

MFR:	SMA
MODEL:	SUNNY CENTRAL 2500-EV
NAMEPLATE:	2500 kVA@35C; 2250 kVA@50C
QUANTITY:	2

MV POWER STATION:

MFR:	SMA
MODEL:	MV POWER STATION 5000-S-AU
QUANTITY:	1

TRACKER ARRAY:

MFR:	NEXTRACKER
MODEL:	NX HORIZON (1P SINGLE-AXIS TRACKER)
CONFIGURATION:	1 MODULE IN PORTRAIT 3 OR 2 STRINGS PER ROW
RANGE OF MOTION:	E-W +/-60°
PITCH:	6 M
GCR:	36.3%
QUANTITY:	1P78 - 138 1P52 - 66

FENCE AREA:	~11.57 HA
LEASE AREA:	~13.25 HA

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN METERS (UNLESS OTHERWISE SPECIFIED) AND ONLY INDICATIVE, TO BE CONFIRMED ON SITE PRIOR TO INSTALLATION.
2. DESIGN BASED ON SITE LEASE BOUNDARIES AND CONTOURS DRAWINGS PROVIDED BY THE CLIENT.
3. 4 m WIDE ROADS HAVE BEEN DRAWN WITH SUFFICIENT SETBACK TO ALLOW ROOM FOR TRENCHING, DRAINAGE SYSTEM AND SAFETY CLEARANCE TO THE PV ARRAY. A PERIMETER CLEARANCE FROM FENCE LINE TO PV MODULE HAS BEEN RESERVED FOR THE ACCESS OF FIRE VEHICLES.
4. LOCATION OF THE PERIMETER FENCE, PV ARRAYS AND BUILDINGS (POWER CONVERSION UNIT, NSP KIOSK, O&M / CONTROL ROOM AND STORAGE BUILDING) ARE INDICATIVE AND MAY CHANGE DURING THE DETAILED DESIGN PHASE.
5. ALL INTERNAL ROAD LOCATIONS ARE PRELIMINARY AND SUBJECT TO CHANGE.
6. FINAL LAYOUT IS SUBJECT TO FINALIZATION OF SITE STUDIES, INCLUDING FLOOD RISK ASSESSMENT, GEOTECHNICAL, ETC.
7. POINT OF CONNECTION (PoC) IS EXPECTED TO BE AT THE SOUTH EASTERN AREA OF THE SITE. EXACT LOCATION TO BE CONFIRMED.
8. BASED ON A HIGH-LEVEL ASSESSMENT OF THE TOPOGRAPHICAL INFORMATION GRADING IS EXPECTED TO BE REQUIRED FOR SOME TRACKERS (REFER TO THOSE HIGHLIGHTED IN YELLOW) TO ENSURE THE MINIMUM CLEARANCE TO GROUND REQUIRED BY THE TRACKER MANUFACTURER.

N

1:1000 0 20 50 100

SCALE IN METERS

PROVIDENCE ASSET GROUP

RINA CONSULTING
WWW.RINAGROUP.ORG
WWW.RINACONSULTING.ORG

PRELIMINARY NOT FOR CONSTRUCTION

SOLAR FARM GENERAL ARRANGEMENT

South Tamworth
Suttons Quarry, Country Road Westdale NSW
NEW SOUTH WALES, AUSTRALIA

REV	DATE	DESCRIPTION	DWN	CHKD
1	03/03/20	ISSUE FOR INITIAL SUBMITTAL	UZ	JLG
2	11/03/20	ISSUE FOR REVISED INITIAL SUBMITTAL	UZ	JLG
3				

LATITUDE: 31.11 ° S
LONGITUDE: 150.871 ° E

SCALE 1:1000

ORIGINAL SIZE: ISO A1

SHEET ST-2

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 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 March 2020).

Development on the eastern side of the Peel River did not begin until November 1835 when James White established what is considered the first permanent residence on that side of the river by opening a combined store and public house on high ground between the river and what was to become Peel Street. Tamworth quickly became a regular stopover point for travellers and a staging point for mail coaches. It began to assume a suite of features of a town, including accommodation houses (the first one being the Peel Inn) and the establishment of the first racecourse in 1840 (TRC 2006: 26).

The gold rush of the 1850s led to the rapid entrenchment of several towns. In July 1850 the first auction sale of town lots at Tamworth took place. The Liverpool Plains had housed the estates of the Australian Agricultural Company since 1832. The company's headquarters became the basis of the town of Tamworth when this urban development began to occur in earnest in the 1850s. By 1861, Tamworth had a population of 654 people and became a link in the traffic route from the north, especially when the railway reached the town in 1873. Tamworth became a municipality in 1876 and by this time it was a successful town with many industries and facilities such as a hospital, banks and schools. In 1888, after building its electricity generating plant, Tamworth became the first town in Australia to use electric lighting and eventually it serviced much of the north of the state (NSW DPIE website, accessed March 2020).

The proposal area itself has been heavily impacted by European settlement. These activities include grazing and more intensive agriculture. Tamworth 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). In more recent times, the central and southern parts of the site have functioned as a quarry, surrounded by a predominantly low grassland and situated within the greater rural plot. The area is subject to heavy sheetwash and erosion due to this long history of cropping, contributed to greatly by the long-term use of disc ploughs in non-rotational farming systems. This heavy land degradation is highly likely to have impacted the retention of any remnant or later topsoils in these rural plots. The combination of farming and quarrying in the project area renders the preservation of intact Aboriginal sites and material culture unlikely.

2.2 Topography, Hydrology and Climate

The site is situated within the Nandewar Peel 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 Peel River sub-catchment is a major part of the Namoi complex, with the head of the river forming in the northern slopes of the Liverpool Ranges and connecting to the Namoi River approximately 210km away near Gunnedah (Burrell *et al.* 2018: 2). This river would have provided water and abundant food resources for Aboriginal people. It represents the nearest major permanent waterway for the project area, and feeds into all major creeks in the vicinity.

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 March 2020). The rainfall in the Nandewar Bioregion is prone to being summer dominant (Morgan and Terrey 1992).

The topography of the Tamworth-Keepit Slopes and Plains Landscape, within which the project area is situated, is characterised by undulating to rolling slopes and extensive plains with low hills and ranges which form the western fall of the New England Plateau. The general elevation in the surrounds of the site is 500 to 800 metres with a local relief of 250m, and major peaks reaching 1100m (Mitchell 2002). The development area ranges from flat plains to rolling slopes, with alluvium at the flat river valley intersections (AREA Environmental Consultants & Communication 2019: 33).

2.3 Geology and Soils

The proposed site is situated between two main geological landscapes. The first is the Glenmore geological landscape, which occurs in small plateaus across the region due to Permian-Tertiary folding of the Tamworth belt. It has been suggested that these features are remnants of the andesitic foot slopes of the Melville Ranges (Banks 2001: 37).

The site is also within the Duri geological landscape, which is a complex mixture of Devonian sedimentary rocks of the Tamworth belt interdigitated with Carboniferous geological units. The lithology of this landscape may have partially been used by Aboriginal people as a resource for the production of stone tools (Robins *et al.* 2015: 24). This landscape has an underlying geology of arenite, mudstone, greywacke and polymictic conglomerate. Divisions between the Devonian and Carboniferous units (Keepit Conglomerate, Mandowa Mudstone, and the Baldwin Formation) can be found in detail on the Tamworth 1:250k Geological Sheet (Offenberg 1971).

The Nandewar Peel Bioregion geology is strongly folded and faulted with marked northwest alignment, with areas of sub-horizontal Carboniferous shales and sandstones in the north. Due to the convergence of multiple geological units in this bioregion, predicting variations in underlying geology and soil types can be difficult. The soil landscape in the area is characterised by shallow stony soils on ridges. Almost all slopes display texture contrast soils ranging from red brown on upper slopes to yellow on lower slopes (NSW DPIE website, accessed March 2020).

Basalt areas contain black earth type soils, while dark, apedal, alkaline clays can be found on underlying

limestone. Serpentinites have shallow stony profiles with concentrations of elements that are toxic to many types of vegetation. Areas with alluvial loams and clays generally demonstrate moderate to high fertility in the Peel subregion (Morgan and Terrey 1992).

Table 1. Soil Landscape Group

SOIL LANDSCAPE GROUP	GEOLOGY	TOPOGRAPHY
Nandewar Peel Bioregion: shallow stony soils on ridges. Texture contrast soils ranging from red brown on upper slopes to yellow on lower slopes. Some black earth type soils and dark alkaline clays on underlying limestone.	Glenmore Landscape with fine grained Silurian to Devonian sedimentary rocks. Strongly folded and faulted with marked northwest alignment. Duri landscape of interdigitated sub-horizontal Carboniferous shales and sandstones in the north. Limited areas of basalt cap from the Nandewar and Liverpool Ranges are included. Linear outcrops of serpentinite and scattered bodies of limestone.	Low peaked hills with north-westerly alignment. Basalt caps of dissected flows, moderate slopes and flat river valleys with alluvium. Karst landscapes in limestone.

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 March 2020).

The vegetated slopes would have provided ample terrestrial resources for Aboriginal people in the past. These would have included many species of birds, snakes, lizards, marsupials, honeyeaters, gliders, tortoises and arboreal mammals (NSW DPIE website, accessed March 2020). While no wetlands exist in the vicinity, the Peel River and connecting creeks 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.

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 March 2020
- The NSW Department of Planning, Industry and Environment website, accessed March 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 Tamworth, 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 Tamworth 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 Weraerai (Wirrayaraay) and the Kwaimbul in the north (NSW DPIE website, accessed March 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 March 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 March 2020). Two of the subgroups of the Kamilaroi people in the immediate area of what was to become Tamworth were the Moonbi people, from the area at the foot of the Moonbi Ranges, and the Goonoo Goonoo people, from the flat lands beside the Peel River (NSW DPIE website, accessed March 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 Darkinung, 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 March 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 Tamworth 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, 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 March 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 March 2020). Watering holes and rivers (such as the Peel 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 March 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).

Moore Creek (known to the Kamilaroi as 'Burkanbandean'), north of Tamworth was an important meeting place, where sacred initiation ceremonies were held as well as corroborees involving the wider group. As Gardner recorded in his journal in 1854:

> At certain seasons of the year the various tribes of the interior met at appointed places, at the general

> rendezvous their disputes were adjusted and settled. In early times the most remarkable of these in the northern interior may be mentioned, as Burkanbandean near Tamworth on Peel River in the district of Liverpool Plains. … Each tribe in addition to their Corraborahs or theatrical merry meetings hold quarterly meetings these are called Borrahs at these meetings no women or children are allowed to attend. At one of these Borrahs the young men of the tribe are passed and a mark is put upon him by breaking one of his front teeth, at this Borrah they are for the first time taken round the Boundaries of the tribe and shown the various marks of their District (cited in Boileau 2007: 9).

The region is known for ornately carved trees, ceremonial bora grounds and art sites, indicating an intimate spiritual, as well as a physical attachment to the sacred landscape the Aboriginal people inhabited (NSW DPIE website, accessed March 2020). Much of the rock art was done by red ochre on granite and consists of human figures accompanied by grid tracks, direction signs, circles, lines and dots (TRC 2006: 6).

These are just a handful of recorded examples of important ceremonial and scared 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 March 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 March 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. During the 1940's and 1950's local Kamilaroi families were living in an Aboriginal Reserve in North Tamworth, and many families to this day still have a strong cultural connection to the site (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 Tamworth 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 Tamworth 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 March 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
- Tamworth Regional Local Environmental Plan (2010).

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 26 February 2020 of the project area to identify if an approved native title claims exist over the project area. The searches indicated that no approved native title claim within the project area (refer to **Appendix B**).

3.2.2 Aboriginal Heritage Information Management System (AHIMS search)

Searches were conducted of the AHIMS register on 26 February 2020 for any Aboriginal heritage sites recorded within and adjacent to the project area. The search covered the area datum: GDA, Zone: 56, Eastings: 296734 – 297179, Northings: 6556233 – 6556307 (approximate 1km buffer from the project area).

A single Aboriginal site was listed (refer to **Appendix C**, and Figure 3). The culturally modified tree, 29-2-0277, was within 1km of the proposed area of works against a fenceline in a cleared paddock. It was, however, not within the boundaries of the project area.

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 26 February 2020 for all Indigenous heritage items within the Tamworth Regional Local Government Area. The AHD search listed 536 results within the Tamworth Regional LGA for heritage places. No heritage items were identified within the immediate project area.

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 the NSW Heritage Branch of the Office of Environment and Heritage. This database includes heritage listings for State significant heritage items. This database was searched on the 26 February 2020, and listed 9 results for state heritage items within the Tamworth Regional Local Government Area.

The results indicate no Aboriginal places within the LGA or within the project area.

3.2.5 Tamworth Regional Local Environmental Plan (2010)

The Tamworth Regional Local Environmental Plan (LEP) is a planning instrument administered by Tamworth Regional 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 26 February 2020.

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

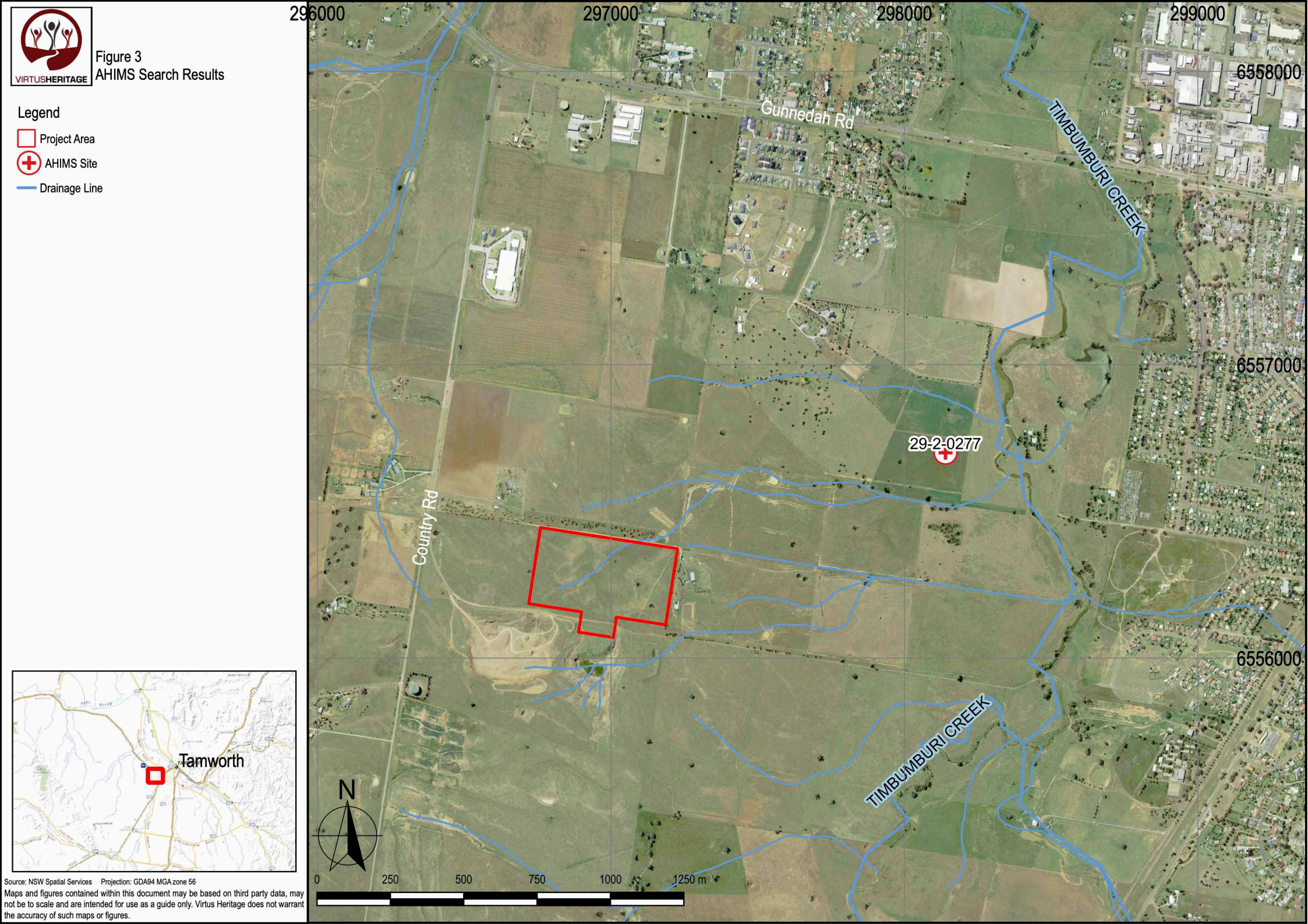


Figure 3
AHIMS Search Results

Legend

- Project Area
- AHIMS Site
- Drainage Line

Source: NSW Spatial Services Projection: GDA94 MGA zone 56

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.

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 a number of studies in the locality that 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.

An archaeological study at the nearby Glen Artney Industrial Development was undertaken in 2015 by Everick Heritage Consultants Pty Ltd (Robins *et al.* 2015). The site is located 3.5 kilometres northwest of the project area. Results of the field survey were presented as part of the due diligence assessment for this development. The industrial site in west Tamworth demonstrated a similarly heavily cultivated agricultural landscape as the project area. A total of six Aboriginal sites were recorded, of which one was a low density artefact scatter, one was a culturally modified tree, and the remainder were isolated artefacts. None of these sites are within the boundaries of the project area.

A similar study for a solar farm between Bective and Somerton was presented by AREA Environmental Consultants & Communication (Brown 2019), in which a field survey was conducted for a Cultural Heritage Assessment. The assessment was commissioned for the development of a solar farm approximately 25 kilometres northwest of this proposed project area. The previous land use history of the site was similar to Tamworth Quarry in that the landscape had been heavily cultivated for agriculture, with low potential for undisturbed Aboriginal sites. As a result of this survey, 23 new sites in total were recorded. Of these, nine were open camp sites, three were culturally modified trees, and the final 11 sites were isolated artefacts. None of these sites are within the project area, but the densities and site types prove similar to those in the study by Robins *et al.* (2015), and aid in predictions of likely site types in the project area.

Table 2. Previous Archaeological Surveys within the Locality

AUTHOR/ DATE	LOCALITY	INVESTIGATION AND DISTANCE TO PROJECT AREA	NO. RECORDED SITES	SITE TYPES	SITES WITHIN PROJECT AREA
Robins *et al.* 2015	West Tamworth	Due diligence Assessment (Field Survey), 3.5 km north west of the project area.	6	Low density artefact scatter, one modified tree, isolated artefacts	0
Brown 2019	Somerton	Cultural Heritage Assessment (Field Survey), 25 km northwest of the project area.	23	9 open camp sites, 11 isolated artefacts, 3 culturally modified trees	0
Wilson and McAdam 2000	Tamworth	No field survey, register of all sites in Tamworth Distance N/A	62	Majority open artefact scatters, with occasional isolated finds, quarry sites, culturally modified tress, and a single instance of white ochre	0
Gaynor 2004	Taminda near Peel River	Archaeological Survey Report 4km east of the project area	1	Isolated artefact	0

3.4 Regional Character

The Kamilaroi people had a prior presence in the New England area for many thousands of years. They 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 local region. Site types include bora grounds/ceremonial grounds, campsites, artefact scatters, stone quarries, isolated finds, scarred and carved trees.

The earliest dates for human occupation in the Tamworth 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). Wilson and McAdam (2000) used historical accounts, Aboriginal oral history, and previous archaeological research to make a number of observations and predictions concerning site types within the Tamworth area, and the likelihood they may have survived. These 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).

Information provided by the National Parks and Wildlife Service in 2004 lists a number of Aboriginal sites in the former Shires of Nundle, Manilla and Barraba (now amalgamated into Tamworth Regional Shire). There were 6 Aboriginal sites in Nundle Shire, including 3 artefacts, 1 rock art site and 2 axe grinding grooves. In Manilla Shire, there were 26 sites, including 10 artefacts, 4 rock art sites, 2 axe grinding grooves, 2 stone arrangements and 8 modified trees (carved or scarred). In Barraba Shire, 16 sites were recorded, including 7 artefacts, 2 art sites, 2 burials, 1 axe grinding groove, 1 stone arrangement and 3 modified trees. Many sites in the Tamworth region have been destroyed by urban development and agricultural activity (Boileau 2007: 15).

Subsequent archaeological investigations have greatly increased the number of registered sites within the Tamworth region, which predominantly support Wilson & McAdam's (2000) findings and predictions.

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.

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:

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 very rare site type, which are considered unlikely to be found in the project area based on its history of previous land use, however the only recorded AHIMS site within the vicinity of the project area is a scarred tree. 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. The objects are most likely to be found within 100 metres of a major water course, well drained alluvial flats, lower slope adjacent water courses, crests, and areas near the lake foreshore where the landscape has not been heavily modified. The project area includes a crest landform, however, as shown by the previous land use history and background research, the project area has also been disturbed and modified. This site type may occur in areas of the project area dependant on the level of disturbance.

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 the landform and proximity to permanent water.

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. These site types, which are very rare site types, are unlikely to be found within the project area in areas of high modification.

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. These site types are unlikely to occur in the project area due to a lack of suitable geology for rock shelters to occur.

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 may occur if suitable geology is present such as outcropping sandstone or suitable sandstone shelves in creek beds. The geology of the project area may have suitable sandstone outcrops for grinding grooves to occur.

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 4.**

Table 2. 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 heavy land degradation is highly likely to have impacted the retention of any remnant or later topsoils in the project area. The combination of farming and quarrying in the project area renders the preservation of intact archaeological deposits unlikely.

4.1. Summary

The project area is in a heavily disturbed landscape, whereby remnant A1 topsoils may have been re-distributed or entirely removed, impacting the potential for intact Aboriginal objects and sites to occur. The project area may contain sandstones which are suitable for grinding grooves, mature trees, and therefore have the potential for scarred or carved trees to occur. The landforms in the project area may be suitable for artefact scatters or isolated finds to occur dependant on the level of disturbance and modification. Other site types, such as stone arrangements, art sites, burials and ceremonial sites such as bora rings are unlikely to occur in the project area.

5. SITE INSPECTION AND RESULTS

The site inspection was undertaken on 5 March 2020 within lands in the Tamworth LALC area. The site inspection was undertaken by Elle Lillis, Senior Archaeologist, Virtus Heritage and Christopher 'Donny' Fermor over one 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 overall project area was very poor due to thick vegetation coverage, however areas of exposure in erosion scours, on contour banks and dam walls and in vehicle tracks provided very good visibility. Exposures in the project area were <10% visibility was approximately 10%. Where visible, soils were red clays with frequent quartz and shale angular gravels and occasional subangular cobbles. Downslope in the east of the project area soils were red loamy clays with frequent gravels, which appear to have been washed downslope due to sheet wash erosion. The entire project area appeared to have been disturbed by European land use associated with farming and quarrying activities. Two dams have been constructed in the project area as well as a number of contour banks on the east facing slope. The area has previously been cleared, vegetation is largely exotic grass and pasture species as well as occasional briar rose bushes, with a small number of mature Eucalypt paddock trees remaining in the project area and adjacent paddock. Adjacent to the quarry the ground surface is entirely disturbed and modified, with excavation and mounding of soils and metal and other modern debris observed in spoil piles. Sheetwash erosion on slopes and gullying erosion in tracks was observed throughout the project area where visibility allowed.

In the south east corner of the project area, on the hill crest and steep upper slope, outcropping andesite was observed. There were some recent negative scars on two of the andesite boulders on the northeast facing slope, which Donny commented may have been an Aboriginal stone resource gathering source. Andesite is a known raw lithic material used for stone tools in the region, however the negative scars were observed to be very recent and the boulders appeared to have been pushed up against the base of a mature Eucalypt tree, this is likely associated with machinery use for adjacent earthworks on the north and east facing slope, which were undertaken between 2013 and 2015 based on a review of satellite imagery. No other Aboriginal objects or sites were observed in this area; however visibility was poor on the adjacent hill crest where further in-situ outcropping andesite occurred.

5.1.1 Potential Scarred Tree TQS-ST1

One potential scarred tree, TQS-ST1, was observed in the northeast of the project area at **GDA 94 MGA zone 56 297096E and 6556251N**. TQS-ST1 is a mature *Eucalyptus conica* (fuzzy box) with one large scar (scar 1) and one small scar (scar 2) on the west side of the tree (refer to **Figure 4**). The tree was in fair condition with minor crown dieback evident and visible stock damage on the base of the trunk on the north and south sides. The tree height is 15-20m and circumference is 3500mm.

Scar 1 has regular edges and starts 1100mm above the ground surface and extends 1200mm length including regrowth, the inner length excluding regrowth was 730mm. The regrowth was 260mm wide on the right side and 300mm on the left side with a width of 70mm between the regrowth and a total width of 630mm. The scar face was approximately 250mm deep, but was damaged and degrading. The size, placement and regularity of this scar indicate that this scar may be of anthropogenic origin. The amount of regrowth, potential age of the tree and condition of the scar face indicate that this scar may also be old enough to be an Aboriginal scarred tree.

Scar 2 was an irregular shape, 430mm from the ground surface with an inner width of 40mm and length of 260mm. Regrowth measured 100mm width on the right side and 70mm on the left side, the face of the scar is in good condition. Mr Fermor commented that this scar indicated that a campsite was located in the vicinity, however the size and placement of this scar as well as the irregular shape indicate that this scar is more likely to be natural. The condition of the scar and amount of regrowth indicate that this scar is also probably more recent than scar 1.

5.1.2 Cultural Comments and Potential for Archaeological Deposits

During the survey, Mr Fermor commented that where any grading or slope profiling works were occurring in the project area that he would like a Tamworth LALC sites officer to be given the opportunity to inspect any excavated material up to 200mm depth. Mr Fermor also commented that the area would not have been used as a campsite, but was a transitory area used while travelling or hunting.

Due to the land use history and high level of disturbance observed during the site survey (where visibility allowed) the project area was determined to have very low potential for intact sub-surface archaeological deposits to occur. A1 topsoils appear to have been displaced by erosion or removed entirely throughout the project area. However, visibility was also very poor throughout the project area which impacted the ability to assess disturbance in areas were vegetation obscured the ground surface.

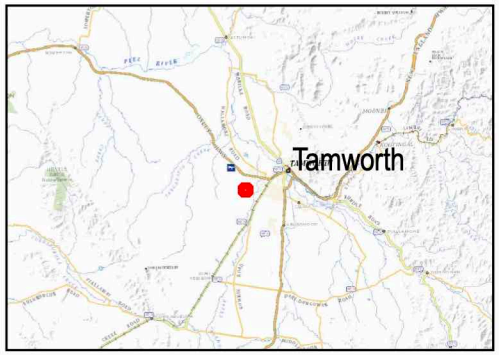
5.2 Summary of Site Inspection

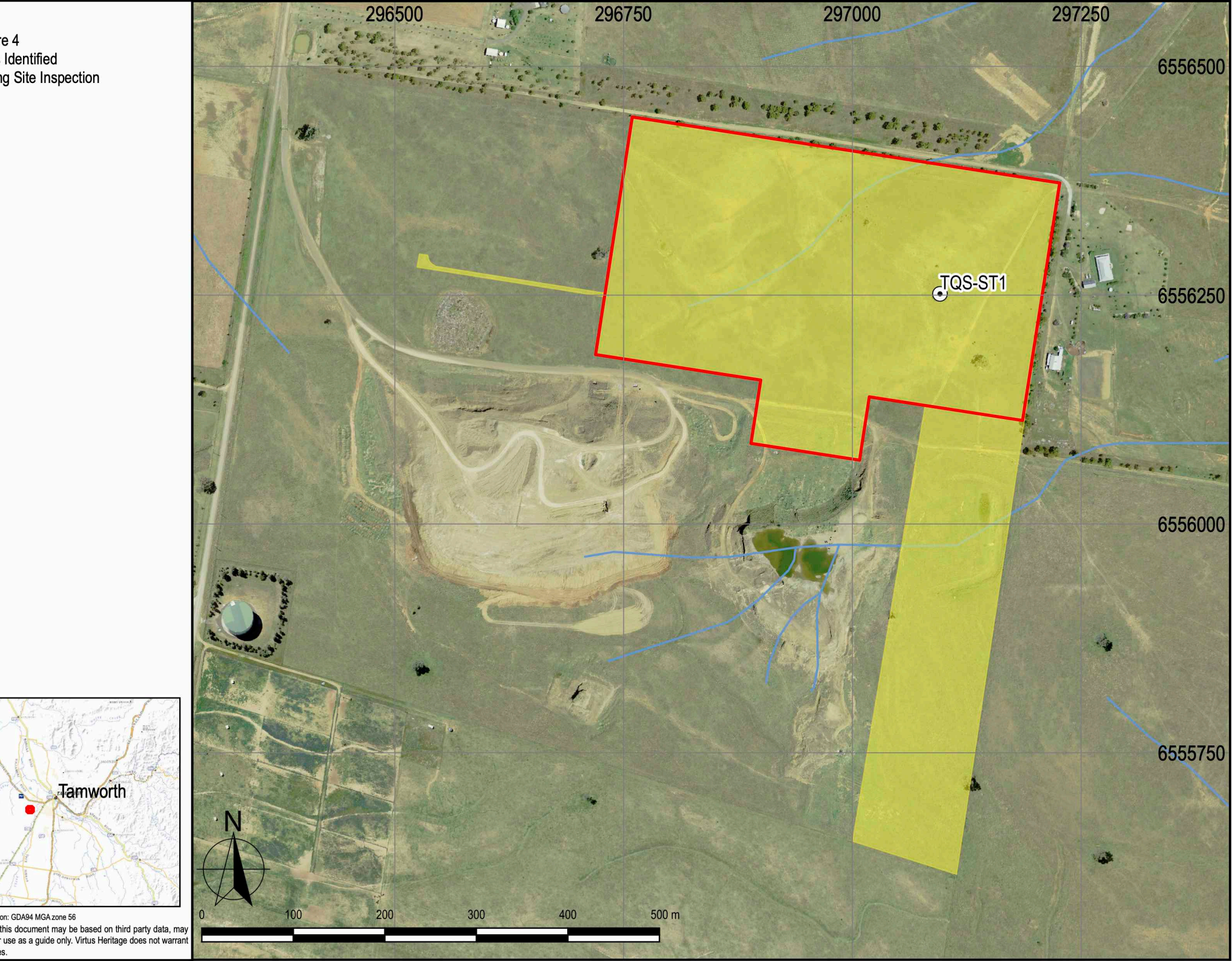
There are no previously recorded sites in the project area based on heritage searches and background research of previous archaeological investigations to date. One potential scarred tree, TQS-ST1, was recorded in the project area during the site inspection, no other Aboriginal objects or sites were observed in the project area and no areas of potential deposit were identified. Due to the previous land use history and high level of disturbance observed during the site inspection, the project area has very low potential for in-situ Aboriginal objects or intact cultural deposits to occur.

Figure 4
Sites Identified
During Site Inspection

Legend

- Project Area
- Survey Area
- Scarred Tree
- Drainage Line





Source: NSW Spatial Services Projection: GDA94 MGA zone 56

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.

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) One potential Aboriginal scarred tree was identified as part of this project (TQS-ST1). The design of the proposal should avoid this area:
    a. If this tree cannot be avoided, it is recommended that a qualified aboriculturalist should assess the tree to identify and assess whether the scarring is cultural or natural, or a result of some other non-cultural process (e.g. vehicle impact) in consultation with relevant Aboriginal parties (Tamworth LALC) and the DPIE.

    b. If the scarring on the tree is determined to be cultural, and impact cannot be avoided as part of the project, then following the provisions of the NPW Act, 1974, further impact and significance assessment is required as it would then be deemed and Aboriginal object and require an Aboriginal Cultural Heritage Assessment (ACHA) (with an Archaeological Survey report) in consultation with relevant Aboriginal parties following the DPIE's *Aboriginal Cultural Heritage Consultation Requirements for proponents* (DECCW, 2010).
2) Mr Fermor commented that where any grading or slope profiling works were occurring in the project area that he would like a Tamworth LALC Sites Officer to be given the opportunity to inspect any excavated material up to 200mm depth. Mr Fermor also commented that the area would not have been used as a campsite, but was a transitory area used while travelling or hunting. Tamworth LALC also commented that Mr Fermor or another Sites Officer be on site when work commences. Providence Asset Group may consider this request, however cultural collection can only occur legally in consultation with the DPIE and relevant Aboriginal stakeholder groups as conditioned within an AHIP.
3) AHIMS site records would be prepared and submitted to DPIE AHIMS for the potential scarred tree, TQS-ST1.
4) 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 additional unknown objects or items are uncovered during excavation.
    a. As part of this induction, the contact telephone numbers of the DPIE 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 the location of the Aboriginal sites within the proposal site 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. Providence Asset Group or delegated authority may wish to consider the input and engagement of interested Aboriginal stakeholder groups and Tamworth LALC in the development of inductions and tool box talks for this project.

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APPENDIX A

COMMENTS FROM ABORIGINAL PARTIES

Gmail by Google

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

178 Tamworth Solar draft due diligence assessment report

4 messages

Mary-Jean Sutton <mj.sutton@virtusheritage.com.au> 11 March 2020 at 21:21
To: fiona@tamworthlalc.com.au, admin@tamworthlalc.com.au
Cc: Elle Lillis <e.lillis@virtusheritage.com.au>, Rosie Turner <Rosie@kdc.com.au>

Hi Fiona and Brittni

Attached is a draft due diligence assessment report for the Tamworth solar project, which Donnie and Elle assessed last week.

Can Tamworth LALC please comment by 23 March 2020?

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

Thanks
Mary-Jean

Dr Mary-Jean Sutton
Principal Archaeologist
PhD - Archaeology, University of Queensland

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Website: www.virtusheritage.com.au

***Winner, Innovation for Cultural Heritage Services for NSW Business Chamber, Northern NSW Regional Awards, and 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.

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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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178_KDC_Providence_Draft Due Diligence_rpt_2a.pdf
4019K

Mary-Jean Sutton <mj.sutton@virtusheritage.com.au> 23 March 2020 at 13:04
To: fiona@tamworthlalc.com.au, admin@tamworthlalc.com.au
Cc: Elle Lillis <e.lillis@virtusheritage.com.au>, Rosie Turner <Rosie@kdc.com.au>, Virtus Consultation <consultation@virtusheritage.com.au>

Hi Fiona and Brittni,

Hope you are all ok at the LALC.

Following up if the LALC has any further comment on the draft due diligence assessment for Tamworth solar project emailed on 11 March?

Could you please let us know today as we need to finalise this report this week?

Thanks so much and stay safe

Mary-Jean
Dr Mary-Jean Sutton
Principal Archaeologist
PhD - Archaeology, University of Queensland

VIRTUSHERITAGE
Phone: (02) 6676 4354
Mobile: 0439 703 886
Email: mj.sutton@virtusheritage.com.au
Website: www.virtusheritage.com.au

***Winner, Innovation for Cultural Heritage Services for NSW Business Chamber, Northern NSW Regional Awards, and Small Business Excellence Awards, Tweed Region (BEATS), 2019**
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Brittni Wann <admin@tamworthlalc.com.au> 6 April 2020 at 09:18
To: Mary-Jean Sutton <mj.sutton@virtusheritage.com.au>, fiona@tamworthlalc.com.au
Cc: Elle Lillis <e.lillis@virtusheritage.com.au>, Rosie Turner <Rosie@kdc.com.au>

Hello

Apologies for the delay in response.

We agree with what Christopher (Donny) has said and recommend that Donny or another Sites Office be on the ground when further work commences. We have no further comment to add.

Have a great week and stay safe.

Regards

Brittni

Brittni Wann
Administration Assistant
Tamworth Local Aboriginal Land Council

PO Box 57

Tamworth NSW 2340

Phone: 02 6766 9028

Fax: 02 6766 9036

Email admin@tamworthlalc.com.au

Click Here to Visit Website

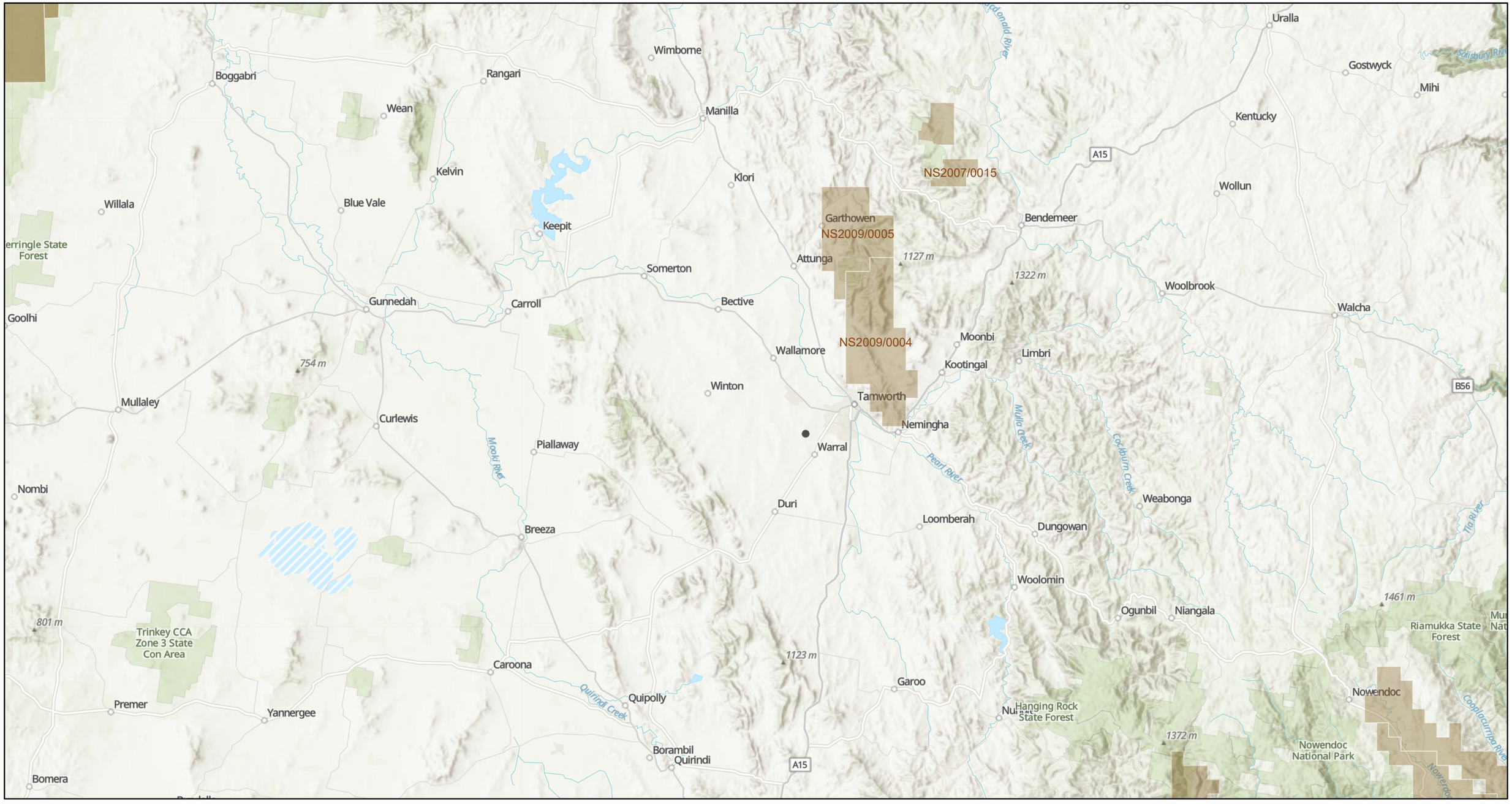
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APPENDIX B

NATIONAL NATIVE TITLE TRIBUNAL SEARCH

Native TitleVision Web Map



26/02/2020, 11:55:46

Future Act Notices (Current)

1:577,791

0 5 10 20 mi

0 10 20 40 km

Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community, Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap

Native TitleVision

Esri, USGS | Esri, HERE, Garmin, FAO, NOAA, USGS |

APPENDIX C

AHIMS SEARCH

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 178 - Quarry Solar

Client Service ID : 486853

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
29-2-0277	DTG/ST 1-Timbumburi Ck	GDA	56	298140	6556700	Open site	Valid	Artefact : -		

Contact	Recorders	Stephanie Garling	Permits

Report generated by AHIMS Web Service on 26/02/2020 for Emma St Pierre for the following area at Datum :GDA, Zone : 56, Eastings : 296734 - 297179, Northings : 6556233 - 6556307 with a Buffer of 1000 meters. Additional Info : Archaeological Assessment. Number of Aboriginal sites and Aboriginal objects found is 1

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.

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : 178 - Quarry Solar

Client Service ID : 486853

Emma St Pierre

PO Box 3485
Newmarket Queensland 4051

Attention: Emma St Pierre

Email: emma.st.pierre@gmail.com

Date: 26 February 2020

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 56, Eastings : 296734 - 297179, Northings : 6556233 - 6556307 with a Buffer of 1000 meters. Additional Info : Archaeological Assessment, conducted by Emma St Pierre on 26 February 2020.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

1	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

3 Marist Place, Parramatta NSW 2150
Locked Bag 5020 Parramatta NSW 2220
Tel: (02) 9585 6380 Fax: (02) 9873 8599

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

56 results found.

ANZ Bank 429-433 Peel St	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Attunga Geological Site Attunga Halls Creek Rd	Attunga, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Attunga State Forest Ornithological Area Inlet Rd	Attunga, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Australia Arms Hotel Group Holroyd St	Moore, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Ben Halls Gap State Forest Morrisons Gap Rd	Ben Halls Gap via Nundle, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Ben Halls Gap State Forest (part) Morrisons Gap Rd	Nundle, NSW, Australia	(Removed from Register or IL) Register of the National Estate (Non-statutory archive)
Bendemeer Public Cemetery Bendemeer Watsons Creek Rd	Bendemeer, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Black Snake Gold Mine Nundle Rd	Hanging Rock via Nundle, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Blair Graves 7 Aurora St	Bendemeer, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Borah Creek Rail Bridge Tamworth Barraba Railway Line	Upper Manilla, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Bowling Alley Point Geological Site	Bowling Alley Point, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Calala Cottage 138-144 Denison St	West Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Carinya Garden 156 Carthage St	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Church of England School and School Masters Residence (former) 63 Bridge St	WestTamworth, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Dominican Convent Group 223-227 Marius St	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Dominican Convent School 223-227 Marius St	Tamworth, NSW, Australia	(Removed from Register or IL) Register of the National Estate (Non-statutory archive)
Dominican Convent and Chapel 223-227 Marius St	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Goonoo Goonoo Chapel New England Hwy	Goonoo Goonoo, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Goonoo Goonoo Complex New England Hwy	Goonoo Goonoo, NSW, Australia	(Registered)

		Register of the National Estate (Non-statutory archive)
Goonoo Goonoo Fountain New England Hwy	Goonoo Goonoo, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Goonoo Goonoo Post Office and Old Store New England Hwy	Goonoo Goonoo, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Goonoo Goonoo Woolshed New England Hwy	Goonoo Goonoo, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Horsley Private Cemetery Glenbarra Rd	Horsley via Manilla, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Indigenous Place	Glendon via Bendemeer, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Indigenous Place	Moonbi, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Indigenous Place	Moore Creek, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Indigenous Place	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Lands Office 25 Fitzroy St	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Linton Nature Reserve Barraba Kingstown Rd	Barraba, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Macdonald River Road Bridge New England Hwy	Bendemeer, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Mechanics Institute (former) 87-93 Brisbane St	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Mount Kaputar National Park Narrabri Bingara Rd	Narrabri, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Namoi River Road Bridge Manilla St	Manilla, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Nundle Courthouse (former) and Police Station Jenkins St	Nundle, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Oaky Creek Rail Bridge Tamworth Barraba Railway Line	Barraba, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Oxley Park Endeavour Dr	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Peel River Rail Bridge Peel St	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Power House Monument 248 Marius St	Tamworth, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)

Royce Cottage Museum 197 Manilla St	Manilla, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Somerton Road Travelling Stock Route (part) Lower Somerton Rd	Manilla, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
St Nicholas Catholic Church 18 White St	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Tamworth Council Chambers and Town Hall (former) 214 Peel St	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Tamworth Gaol (former) 154 Johnston St	Tamworth, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Tamworth Hospital (Main Block only) 31 Dean St	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Tamworth Post Office 402A Peel St	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Tamworth Post Office 402A Peel St	Tamworth, NSW, Australia	(Listed place) Commonwealth Heritage List
Tamworth Primary School Upper St	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Tamworth Town Hall 28-30 Fitzroy St	Tamworth, NSW, Australia	(Rejected Place) Register of the National Estate (Non-statutory archive)
Upper Dungowan Uniting Church Nowendal Rd	Dungowan, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Warrabah National Park Namoi River Rd	Kingstown, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Warrabah Nature Reserve (former) Namoi River Rd	Kingstown, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Watsons Creek Nature Reserve	Watsons Creek, NSW, Australia	(Indicative Place) Register of the National Estate (Non-statutory archive)
Weabonga Geological Site	Woolomin, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Wesley Uniting Church 144 Marius St	Tamworth, NSW, Australia	(Rejected Place) Register of the National Estate (Non-statutory archive)
Winton Cemetery Woodland Remnant New Winton Rd	Tamworth, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)
Woolomin Geological Site	Woolomin, NSW, Australia	(Registered) Register of the National Estate (Non-statutory archive)

Section 2. Items listed under the NSW Heritage Act.

Your search returned 9 records.

Item name	Address	Suburb	LGA	SHR
Dominican Roman Catholic Convent	Marius Street	Tamworth (East)	Tamworth Regional	122
King George V Avenue of Memorial English Oaks	King George V Memorial Avenue	Tamworth (East)	Tamworth Regional	1922
Manilla railway underbridges	Tamworth-Barraba railway	Manilla	Tamworth Regional	1045
Moonby House	New England Highway	Kootingal	Tamworth Regional	61
Tamworth Peel Barracks	Peel Street (cnr)	Tamworth	Tamworth Regional	550
Tamworth Post Office	Fitzroy Street	Tamworth	Tamworth Regional	1421
Tamworth rail bridge over Peel River	Main Northern railway 454.125 km	Tamworth	Tamworth Regional	1058
Tamworth Railway Station, yard group and movable relics	Main Northern railway	Tamworth	Tamworth Regional	1260
Woolbrook rail bridge over McDonald River	Main Northern Railway	Woolbrook	Walcha	1067

ItemName	0

Section 3. Items listed by Local Government and State Agencies.

Your search returned 536 records.

Item name	Address	Suburb	LGA	Information source
Abbey, The	43-45 Rowan Street	Manilla	Tamworth Regional	LGOV
Airlie House at Airlie Station	Airlie Station Road	Bendemeer	Tamworth Regional	LGOV
Airlie Station Fireplace	Airlie Station Road	Bendemeer	Tamworth Regional	LGOV
Airlie Station Woolshed	Airlie Station Road	Bendemeer	Tamworth Regional	LGOV
All Saints Church of England	70 Jenkins Street	Nundle	Tamworth Regional	LGOV
'Angelsea' Residence	Woodsreef Road	Barraba	Tamworth Regional	LGOV
ANZ Bank Building	429 Peel Street	Tamworth	Tamworth Regional	LGOV
Anzac Park Gates	Brisbane Street	Tamworth	Tamworth Regional	LGOV
Anzac Park Gazebo	Brisbane Street	Tamworth	Tamworth Regional	LGOV
Attunga Cemetery	Ridge Street	Attunga	Tamworth Regional	LGOV
Attunga Hall	Attunga Street	Attunga	Tamworth Regional	LGOV
Attunga Hotel	1-3 Attunga Street	Attunga	Tamworth Regional	LGOV
Attunga Silos	Attunga Street	Attunga	Tamworth Regional	LGOV
Attunga Youth Hall	11-15 Attunga Street	Attunga	Tamworth Regional	LGOV
Australian Winter Cereal Collection	Calala Lane	Tamworth	Tamworth Regional	SGOV
Bank	129 Queen Street	Barraba	Tamworth Regional	LGOV
Bank of New South Wales Building	147 Manilla Street	Manilla	Tamworth Regional	LGOV
Baptist Church	86 Carthage Street	Tamworth	Tamworth Regional	LGOV
Barraba (Ennisdale), Oakey Creek Underbridge	534.118km, West Tamworth To Barraba Railway	Ennisdale	Tamworth Regional	SGOV
Barraba Cemetery	West Street	Barraba	Tamworth Regional	LGOV
Barraba District Hospital	Gotha Street	Barraba	Tamworth Regional	LGOV
Barraba Primary School	Gotha Street	Barraba	Tamworth Regional	LGOV
Barraba Senior Citizens Centre	50 Fitzroy Street	Barraba	Tamworth Regional	LGOV
Barraba Showground and Racecourse	Mulwaree Road	Barraba	Tamworth Regional	LGOV
Bective Station	Oxley Highway	Bective	Tamworth Regional	LGOV
Bective Station - Laundry	Oxley Highway	Bective	Tamworth Regional	LGOV
Bective Station - Salt Shed and Butchers Hut	Oxley Highway	Bective	Tamworth Regional	LGOV
Bective Station - Shearing Shed and Herefed Stud Sheds	Oxley Highway	Bective	Tamworth Regional	LGOV
Bendemeer Café	141-143 Caroline Street	Bendemeer	Tamworth Regional	LGOV
Bendemeer Hotel	112-130 Caroline Street	Bendemeer	Tamworth Regional	LGOV
Bendemeer Police Station	157 Caroline Street	Bendemeer	Tamworth Regional	LGOV
Bendemeer Police Station and Official Residence	Aurora Street and Caroline Street, corner Of	Bendemeer	Tamworth Regional	SGOV
Bendemeer Public Cemetery	Caroline Street	Bendemeer	Tamworth Regional	LGOV
Bendemeer Public School	Charles Street	Bendemeer	Tamworth Regional	LGOV
Bendemeer Station	New England Highway	Bendemeer	Tamworth Regional	LGOV
Bendemeer Station - Blacksmiths Store	New England Highway	Bendemeer	Tamworth Regional	LGOV
Bendemeer Station - Grave of Thomas Perry	New England Highway	Bendemeer	Tamworth Regional	LGOV
Bendemeer Station - Woolshed	New England Highway	Bendemeer	Tamworth Regional	LGOV
Bendemeer Town Hall	87-89 Caroline Street	Bendemeer	Tamworth Regional	LGOV
Bendemeer Uniting Church	135-139 Caroline Street (Corner)	Bendemeer	Tamworth Regional	LGOV
Black Snake Gold Mine	Nundle Road	Hanging Rock	Tamworth Regional	LGOV
Blair Graves - Within Haning	155 Caroline Street	Bendemeer	Tamworth Regional	LGOV
Bon Accord	Oxley Highway	Bective	Tamworth Regional	LGOV
Bowling Alley Point Dungowan Parish General Cemetery		Bowling Alley Point	Tamworth Regional	LGOV
Bowling Alley Point Geological Site		Bowling Alley Point	Tamworth Regional	LGOV
Bowling Alley Point School		Bowling Alley Point	Tamworth Regional	LGOV
Bowling Alley Point Union Church		Bowling Alley Point	Tamworth Regional	LGOV
Bridges Over Railway at Tintinhull	New England Highway South	Tintinhull	Tamworth Regional	LGOV
Brigalow Reserve	Oxley Highway	Bective	Tamworth Regional	LGOV
Butcher Shop	195 Manilla Street	Manilla	Tamworth Regional	LGOV
Catholic Church	Britten Street	Weabonga	Tamworth Regional	LGOV
Cellar Storeroom for Coach and Horses Inn	New England Highway	Moonbi	Tamworth Regional	LGOV
Central Hotel	330-334 Peel Street	Tamworth	Tamworth Regional	LGOV
Chaffey Dam	Peel River	Tamworth	Tamworth Regional	SGOV
Chinese Pioneers Memorial Garden	197 Manilla Street	Manilla	Tamworth Regional	LGOV
Christ Church Anglican	Ridge Street	Attunga	Tamworth Regional	LGOV
Church	63 Gill Street	Nundle	Tamworth Regional	LGOV
Clifton Hall	100 Queen Street	Barraba	Tamworth Regional	LGOV
Commercial Building	226 Peel Street	Tamworth	Tamworth Regional	LGOV
Commercial Hotel	136 Queen Street	Barraba	Tamworth Regional	LGOV
Commonwealth Bank Building	404 Peel Street	Tamworth	Tamworth Regional	LGOV
Community Centre	214 Peel Street	Tamworth	Tamworth Regional	LGOV
Cottage	37 Griffin Avenue	East Tamworth	Tamworth Regional	LGOV
Cottage	39 Griffin Avenue	East Tamworth	Tamworth Regional	LGOV
Cottage	46 Griffin Avenue	East Tamworth	Tamworth Regional	LGOV
Cottage	47 Griffin Avenue	East Tamworth	Tamworth Regional	LGOV

Cottage	48 Griffin Avenue	East Tamworth	Tamworth Regional	LGOV
Cottage	51 Griffin Avenue	East Tamworth	Tamworth Regional	LGOV
Cottage	56 Griffin Avenue	East Tamworth	Tamworth Regional	LGOV
Courthouse Hotel	232 Peel Street	Tamworth	Tamworth Regional	LGOV
Courthouse Hotel	85 Manilla Street	Manilla	Tamworth Regional	LGOV
Courthouse Museum	38-40 Jenkins Street	Nundle	Tamworth Regional	LGOV
Dalblair Homestead	Dalblair Lane	Winton	Tamworth Regional	LGOV
Daruka Station	80 Wyndham Close	Daruka	Tamworth Regional	LGOV
Dingley Dell Uniques	Main Road	Upper Manilla	Tamworth Regional	LGOV
Dungowan Cemetery	Ogunbil Road	Dungowan	Tamworth Regional	LGOV
Dungowan Memorial Hall	Nowendoc Road	Dungowan	Tamworth Regional	LGOV
Dungowan Public School	Dungowan Creek Road	Dungowan	Tamworth Regional	LGOV
Dungowan Store, Post Office and Residence	Nundle Road	Dungowan	Tamworth Regional	LGOV
Durham	Calala Lane	Tamworth	Tamworth Regional	SGOV
Duri Community Hall	2 Duri Street	Duri	Tamworth Regional	LGOV
Duri Silos	Duri Street	Duri	Tamworth Regional	LGOV
Dwelling	30-32 Darling Street	Tamworth	Tamworth Regional	LGOV
East Tamworth Station Pedestrian Bridge	Bourke Street	Tamworth	Tamworth Regional	LGOV
Eastern Railway Viaduct	Peel Street	Tamworth	Tamworth Regional	LGOV
Entrance to Endeavour Drive, Street Lights	Endeavour Drive	Tamworth	Tamworth Regional	LGOV
Factory	Corner Court Street	Manilla	Tamworth Regional	LGOV
Five Head Stamping Battery	Niangala Common	Niangala	Tamworth Regional	LGOV
Former Anglican Church	Mitchell Street	Weabonga	Tamworth Regional	LGOV
Former Bendemeer Butchery and Residence	113 Caroline Street	Bendemeer	Tamworth Regional	LGOV
Former Brewery Building	130-138 Peel Street	Tamworth	Tamworth Regional	LGOV
Former Butchery	Nundle Road	Dungowan	Tamworth Regional	LGOV
Former Catholic Church	Cnr Tangaratta and Warral Streets	Duri	Tamworth Regional	LGOV
Former Commonweath Bank - Curlew	11 Singh Street	Woolbrook	Tamworth Regional	LGOV
Former Court House	127 Queen Street	Barraba	Tamworth Regional	LGOV
Former Manvell's Bakery	Nundle Road	Dungowan	Tamworth Regional	LGOV
Former Post Office - Craigowan	Lower Watsons Creek Road	Watsons Creek	Tamworth Regional	LGOV
Former Square Man Hotel and Old Flour Mill	165-169 Peel Street	Tamworth	Tamworth Regional	LGOV
Former Store - Gunadoo	Corner of Glen Barra Road	Watsons Creek	Tamworth Regional	LGOV
Former Store and Old Butcher Shop	Healy Street	Niangala	Tamworth Regional	LGOV
General Store and Stable	109-111 Caroline Street	Bendemeer	Tamworth Regional	LGOV
German Machine Gun, Rotary Park	Manilla Street	Manilla	Tamworth Regional	LGOV
Gidley Storage (wheat silos)	Wallamore Road	Gidley	Tamworth Regional	LGOV
Girl Guides Manilla	68 Court Street	Manilla	Tamworth Regional	LGOV
Glen Innes Courthouse	Grey Street	Glen Innes	Tamworth Regional	SGOV
Glenview - Residence	Garthowen Road	Attunga	Tamworth Regional	LGOV
Goonoo Goonoo Station - Group of Buildings	Goonoo Goonoo New England Highway	Tamworth	Tamworth Regional	LGOV
Grandstand (at race track)	Britten Road	Tamworth	Tamworth Regional	LGOV
Great War Memorial (Clock Tower)	Queen and Maude Streets Intersection	Barraba	Tamworth Regional	LGOV
Group of Shops	235-237 Peel Street	Tamworth	Tamworth Regional	LGOV
Group of Shops	239 Peel Street	Tamworth	Tamworth Regional	LGOV
Group of Shops	164 Peel Street	Tamworth	Tamworth Regional	LGOV
Hallsville Hall	Manilla Road	Hallsville	Tamworth Regional	LGOV
Hallsville Methodist Church (Former)	Manilla Road	Hallsville	Tamworth Regional	LGOV
Hallsville Methodist Church Cemetery	Manilla Road	Hallsville	Tamworth Regional	LGOV
Hallsville Public School	Manilla Road	Hallsville	Tamworth Regional	LGOV
Hanging Rock Historic Cemetery	Forest Way	Hanging Rock	Tamworth Regional	LGOV
Haning	Longford Retreat Road	Bendemeer	Tamworth Regional	LGOV
Herbarium	Calala Lane	Tamworth	Tamworth Regional	SGOV
Hospital - Allambie	100 Marius Street	North Tamworth	Tamworth Regional	LGOV
Hotel	117-123 Queen Street	Barraba	Tamworth Regional	LGOV
Hotel & Shops	395-401 Peel Street	Tamworth	Tamworth Regional	LGOV
Hotel Tattersalls	146-148 Peel Street	Tamworth	Tamworth Regional	LGOV
House	55 Upper Street	Tamworth	Tamworth Regional	LGOV
House	57 Upper Street	Tamworth	Tamworth Regional	LGOV
House	59 Upper Street	Tamworth	Tamworth Regional	LGOV
House	83 Upper Street	Tamworth	Tamworth Regional	LGOV
House	89 Upper Street	Tamworth	Tamworth Regional	LGOV
House	86 Marius Street	Tamworth	Tamworth Regional	LGOV
House	14 Gipps Street	West Tamworth	Tamworth Regional	LGOV
House	15 Gipps Street	Tamworth	Tamworth Regional	LGOV
House	17 Gipps Street	Tamworth	Tamworth Regional	LGOV
House	48 White Street	Tamworth	Tamworth Regional	LGOV
House	19 Gipps Street	West Tamworth	Tamworth Regional	LGOV
House	56 White Street	Tamworth	Tamworth Regional	LGOV
House	77 White Street	Tamworth	Tamworth Regional	LGOV
House	79 White Street	Tamworth	Tamworth Regional	LGOV
House	93 Denne Street	West Tamworth	Tamworth Regional	LGOV
House	95 Denne Street	West Tamworth	Tamworth Regional	LGOV
House	115 Denne Street	West Tamworth	Tamworth Regional	LGOV
House	98 Goonan Street	Tamworth	Tamworth Regional	LGOV
House	59 Fitzroy Street	Tamworth	Tamworth Regional	LGOV
House	21 Gipps Street	West Tamworth	Tamworth Regional	LGOV
House	22 Gipps Street	West Tamworth	Tamworth Regional	LGOV
House	144 Marius Street	Tamworth	Tamworth Regional	LGOV
House	50 White Street	Tamworth	Tamworth Regional	LGOV
House	123 Marius Street	Tamworth	Tamworth Regional	LGOV

House	204-208 Marius Street	Tamworth	Tamworth Regional	LGOV
House	26 Gipps Street	West Tamworth	Tamworth Regional	LGOV
House	68 Griffin Avenue	East Tamworth	Tamworth Regional	LGOV
House	94 Griffin Avenue	Tamworth	Tamworth Regional	LGOV
House	96 Griffin Avenue	Tamworth	Tamworth Regional	LGOV
House	33 Hill Street	Tamworth	Tamworth Regional	LGOV
House	43 Hill Street	Tamworth	Tamworth Regional	LGOV
House	65 Hill Street	Tamworth	Tamworth Regional	LGOV
House	2-24 King George V Avenue	Tamworth	Tamworth Regional	LGOV
House	16 Macquarie Street	North Tamworth	Tamworth Regional	LGOV
House	18 Macquarie Street	Tamworth	Tamworth Regional	LGOV
House	29 Napier Street	Tamworth	Tamworth Regional	LGOV
House	31 Napier Street	Tamworth	Tamworth Regional	LGOV
House	66A Napier Street	Tamworth	Tamworth Regional	LGOV
House	76 Fitzroy Street	Tamworth	Tamworth Regional	LGOV
House	96 Fitzroy Street	Tamworth	Tamworth Regional	LGOV
House	98 Fitzroy Street	Tamworth	Tamworth Regional	LGOV
House	122 Fitzroy Street	Tamworth	Tamworth Regional	LGOV
House	150 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	153 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	170 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	178 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	15 Church Street	West Tamworth	Tamworth Regional	LGOV
House	65 Church Street	West Tamworth	Tamworth Regional	LGOV
House	75 Church Street	West Tamworth	Tamworth Regional	LGOV
House	77 Church Street	West Tamworth	Tamworth Regional	LGOV
House	61 Darling Street	Tamworth	Tamworth Regional	LGOV
House	63 Darling Street	Tamworth	Tamworth Regional	LGOV
House	65 Darling Street	Tamworth	Tamworth Regional	LGOV
House	67 Darling Street	Tamworth	Tamworth Regional	LGOV
House	69 Darling Street	Tamworth	Tamworth Regional	LGOV
House	67 Denison Street	West Tamworth	Tamworth Regional	LGOV
House	89 Denison Street	West Tamworth	Tamworth Regional	LGOV
House	91 Denison Street	West Tamworth	Tamworth Regional	LGOV
House	99 Denison Street	West Tamworth	Tamworth Regional	LGOV
House	123 Brisbane Street	Tamworth	Tamworth Regional	LGOV
House	129 Brisbane Street	Tamworth	Tamworth Regional	LGOV
House	141A-141B Brisbane Street	Tamworth	Tamworth Regional	LGOV
House	149 Brisbane Street	Tamworth	Tamworth Regional	LGOV
House	102 Brisbane Street	Tamworth	Tamworth Regional	LGOV
House	134 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	138 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	140 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	142 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	79 Church Street	West Tamworth	Tamworth Regional	LGOV
House	95 Crown Street	West Tamworth	Tamworth Regional	LGOV
House	97 Crown Street	West Tamworth	Tamworth Regional	LGOV
House	8 Darling Street	Tamworth	Tamworth Regional	LGOV
House	10 Darling Street	Tamworth	Tamworth Regional	LGOV
House	16 Darling Street	Tamworth	Tamworth Regional	LGOV
House	38 Bourke Street	North Tamworth	Tamworth Regional	LGOV
House	100-102 Bourke Street	North Tamworth	Tamworth Regional	LGOV
House	43 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	45 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	47 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	64 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	75 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	77 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	79 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	81 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	92 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	94-96 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	95 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	100 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	89 Carthage Street	Tamworth	Tamworth Regional	LGOV
House	46A White Street	Tamworth	Tamworth Regional	LGOV
House	47 White Street	Tamworth	Tamworth Regional	LGOV
House	52 White Street	Tamworth	Tamworth Regional	LGOV
House	King George V Avenue	Tamworth	Tamworth Regional	LGOV
House	116 North Street	Tamworth	Tamworth Regional	LGOV
House	130 North Street	Tamworth	Tamworth Regional	LGOV
House	132 North Street	Tamworth	Tamworth Regional	LGOV
House	29 Parry Street	West Tamworth	Tamworth Regional	LGOV
House	48-50 Peel Street	Tamworth	Tamworth Regional	LGOV
House	28 Piper Street	North Tamworth	Tamworth Regional	LGOV
House	42 Raglan Street	Tamworth	Tamworth Regional	LGOV
House	64 Raglan Street	Tamworth	Tamworth Regional	LGOV
House	10 Rawson Avenue	Tamworth	Tamworth Regional	LGOV
House	14 Rawson Avenue	Tamworth	Tamworth Regional	LGOV
House	19 Rawson Avenue	Tamworth	Tamworth Regional	LGOV
House	21 Rawson Avenue	Tamworth	Tamworth Regional	LGOV
House	23 Rawson Avenue	Tamworth	Tamworth Regional	LGOV
House	62 Rawson Avenue	Tamworth	Tamworth Regional	LGOV
House	35 Roderick Street	Tamworth	Tamworth Regional	LGOV

House	65 Roderick Street	Tamworth	Tamworth Regional	LGOV
House	79 Roderick Street	Tamworth	Tamworth Regional	LGOV
House	24 Upper Street	Tamworth	Tamworth Regional	LGOV
House	117 Upper Street	Tamworth	Tamworth Regional	LGOV
House	119 Upper Street	Tamworth	Tamworth Regional	LGOV
House	121 Upper Street	Tamworth	Tamworth Regional	LGOV
House	38 Upper Street	Tamworth	Tamworth Regional	LGOV
House	40 Upper Street	Tamworth	Tamworth Regional	LGOV
House	44 Upper Street	Tamworth	Tamworth Regional	LGOV
House	King George V Avenue	Tamworth	Tamworth Regional	LGOV
House	34 White Street	Tamworth	Tamworth Regional	LGOV
House	46 White Street	Tamworth	Tamworth Regional	LGOV
House - Avondale	66 Napier Street	Tamworth	Tamworth Regional	LGOV
House - Broms-grove	72 White Street	East Tamworth	Tamworth Regional	LGOV
House - Calala	138-144 Denison Street	West Tamworth	Tamworth Regional	LGOV
House - Carrick	120 Denison Street	West Tamworth	Tamworth Regional	LGOV
House - Girrawilla	62 Napier Street	Tamworth	Tamworth Regional	LGOV
House - Glen Evilly	53-55 White Street	Tamworth	Tamworth Regional	LGOV
House - Glen Moor	106 Brisbane Street	Tamworth	Tamworth Regional	LGOV
House - Glenbrook	28 Nundle Road	Tamworth	Tamworth Regional	LGOV
House - Marius Cottage	112 Marius Street	Tamworth	Tamworth Regional	LGOV
House - Minna-murra	69 White Street	Tamworth	Tamworth Regional	LGOV
House - Salona	90 Carthage Street	Tamworth	Tamworth Regional	LGOV
House - St Austel	130 Marius Street	Tamworth	Tamworth Regional	LGOV
House - Strathmore	11 Gipps Street	West Tamworth	Tamworth Regional	LGOV
House - The Cottage	141 Marius Street	Tamworth	Tamworth Regional	LGOV
House - The Pines	28 Hill Street	Tamworth	Tamworth Regional	LGOV
House beside Retreat Theatre	63 Bridge Street	West Tamworth	Tamworth Regional	LGOV
House -Shield Hill	32 Upper Street	Tamworth	Tamworth Regional	LGOV
Houses	51 & 53 Upper Street	Tamworth	Tamworth Regional	LGOV
Imperial Hotel	181-195 Marius Street	Tamworth	Tamworth Regional	LGOV
Imperial Hotel	230 Manilla Street	Manilla	Tamworth Regional	LGOV
Insect and Associates Collection	Calala Lane	Tamworth	Tamworth Regional	SGOV
Iron Footbridge		Bowling Alley Point Recreation Reserve Chaffey Dam	Tamworth Regional	LGOV
Ivanhoe Residence	37 Edward Street	Barraba	Tamworth Regional	LGOV
Jacob's Building (Barraba Information Centre)	114-116 Queen Street	Barraba	Tamworth Regional	LGOV
Jenkins St Antiques	83 Jenkins Street	Nundle	Tamworth Regional	LGOV
Jenkins St Guest House	85 Jenkins Street	Nundle	Tamworth Regional	LGOV
Junction of Manilla And Namoi Rivers	River Street	Manilla	Tamworth Regional	LGOV
Kissing Gate	Limbri Village - Railway Land	Limbri	Tamworth Regional	LGOV
Kootingal Hotel	18-20 Gate Street	Kootingal	Tamworth Regional	LGOV
Kootingal Police Station	Denman Avenue	Kootingal	Tamworth Regional	LGOV
Kootingal Public School	Denman Avenue	Kootingal	Tamworth Regional	LGOV
Kootingal War Memorial	Gate Street	Kootingal	Tamworth Regional	LGOV
Kootingal/ Moonbi Cemetery	Limbri Road (Corner)	Kootingal	Tamworth Regional	LGOV
Lands Office	25 Fitzroy Street	Tamworth	Tamworth Regional	LGOV
Limbri Church	17 Church Street	Limbri	Tamworth Regional	LGOV
Limbri Gatehouse	Limbri Road (Corner)	Limbri	Tamworth Regional	LGOV
Limbri School	Limbri Road	Kootingal	Tamworth Regional	LGOV
Limbri Store and Post Office (Former)	Corner of Limbri Road	Limbri	Tamworth Regional	LGOV
Longford Station	Lonngford Retreat Road	Bendemeer	Tamworth Regional	LGOV
Loomberah War Memorial Hall	Dungowan Road (Corner)	Loomberah	Tamworth Regional	LGOV
Main Block	Dean Street	Tamworth	Tamworth Regional	SGOV
Main Group of Hospital Buildings	31 Dean Street	Tamworth	Tamworth Regional	LGOV
Main School Building - Calrossy	140 Brisbane Street	Tamworth	Tamworth Regional	LGOV
Manilla And District Soldiers Memorial Hall	193 Manilla Street	Manilla	Tamworth Regional	LGOV
Manilla Cemetery	Namoi River Road	Manilla	Tamworth Regional	LGOV
Manilla Central School	Arthur Street	Manilla	Tamworth Regional	LGOV
Manilla Courthouse	Corner Manilla Street	Manilla	Tamworth Regional	LGOV
Manilla Courthouse	Court Street	Manilla	Tamworth Regional	SGOV
Manilla Historical Cemetery	River Street	Manilla	Tamworth Regional	LGOV
Manilla Masonic Centre	56 Court Street	Manilla	Tamworth Regional	LGOV
Manilla Motors	240 Manilla Street	Manilla	Tamworth Regional	LGOV
Manilla Official Residence 1	27 Court Street	Manilla	Tamworth Regional	SGOV
Manilla Official Residence 2	62 Manilla Street	Manilla	Tamworth Regional	SGOV
Manilla Pharmacy Building	204-206 Manilla Street	Manilla	Tamworth Regional	LGOV
Manilla Post Office	164 Manilla Street	Manilla	Tamworth Regional	LGOV
Manilla River Bridge	Main Road 63	0.8 km north of Barraba	Tamworth Regional	SGOV
Manilla RSL	Court Street	Manilla	Tamworth Regional	LGOV
Manilla Showground	River Street	Manilla	Tamworth Regional	LGOV
Manilla Street Clock	Cross Manilla and Strafford Sts	Manilla	Tamworth Regional	LGOV
Manilla, Namoi River Underbridge and timber floodplain viaducts	Railway Location, Barraba Line, 501.047 Kms.	.	Tamworth Regional	SGOV
Marius Cottage	112 Marius Street	Tamworth	Tamworth Regional	SGOV
Masonic Temple	462-464 Peel Street	Tamworth	Tamworth Regional	LGOV
Matilda Park	Appleby Lane	Appleby	Tamworth Regional	LGOV
Mechanics Institute	87 Brisbane Street	Tamworth	Tamworth Regional	LGOV
Monument	Peel Street	Tamworth	Tamworth Regional	LGOV
Monuments at the Tamworth Cemetery	Showground Road	Tamworth	Tamworth Regional	LGOV
Moonbi Lookout	New England Highway	Moonbi	Tamworth Regional	LGOV
Moonbi War Memorial Hall	Gill Street	Moonbi	Tamworth Regional	LGOV

Moonby House	New England Highway North, Located Within Moonbi Retirement Village	Kootingal	Tamworth Regional	LGOV
Moonby House Graves	New England Highway North Located Within Moonbi Retirement Village	Kootingal	Tamworth Regional	LGOV
Moonby House Out House	New England Highway North, Located Within Moonbi Retirement Village	Kootingal	Tamworth Regional	LGOV
Moore Creek Dam	Moore Creek (4Wd Access Only Off Upper Moore Creek Road and Access (4Wd?) Off New England Highway - Gully Road)	Moore Creek	Tamworth Regional	LGOV
Moore Creek War Memorial Hall	Upper Moore Creek Road	Moore Creek	Tamworth Regional	LGOV
Morrow's Row (Group)	1-21 Savoy Street	Barraba	Tamworth Regional	LGOV
Namoi River Bridge	Secondary Road 63	Manilla	Tamworth Regional	LGOV
Namoi River Bridge	63 Manilla Street	Manilla	Tamworth Regional	LGOV
Namoi River Bridge at Manilla	Secondary Road 63	Manilla	Tamworth Regional	SGOV
Nandewar Historical Society Building	71 Queen Street	Barraba	Tamworth Regional	LGOV
National Australia Bank Building	400-402 Peel Street	Tamworth	Tamworth Regional	LGOV
Nemingha Anglican Church	Nundle Road	Nemingha	Tamworth Regional	LGOV
Nemingha School (Former)	Nundle Road	Nemingha	Tamworth Regional	LGOV
Nemingha War Memorial Hall/Nemingha Reserve	Kootingal Road	Nemingha	Tamworth Regional	LGOV
New England Credit Union Building	168 Manilla Street	Manilla	Tamworth Regional	LGOV
Niangala Cemetery	Niangala - Weabonga Road	Niangala	Tamworth Regional	LGOV
Niangala War Memorial Hall and Reserve	Niangala Road	Niangala	Tamworth Regional	LGOV
Niangala Weir	Niangala - Weabonga Road	Niangala	Tamworth Regional	LGOV
Nundle Cemetery	Nundle Creek Road	Nundle	Tamworth Regional	LGOV
Nundle Memorial Hall	101 Jenkins Street	Nundle	Tamworth Regional	LGOV
Nundle Police Station	Gill Street, Corner Durban Street and Jenkins Street	Nundle	Tamworth Regional	SGOV
Nundle Post Office	91 Jenkins Street	Nundle	Tamworth Regional	LGOV
Nundle Public School	Jenkins Street	Nundle	Tamworth Regional	LGOV
Nundle Shire Office	58 Jenkins Street	Nundle	Tamworth Regional	LGOV
Odgers and McClelland Exchange Stores	81 Jenkins Street	Nundle	Tamworth Regional	LGOV
Office Building	12A Bourke Street	Tamworth	Tamworth Regional	LGOV
OFT Movable Heritage - Weights & Measures	Bradfield Road	West Lindfield	Willoughby	SGOV
Ogunbil Brick Shearing Shed and Silo	Ogunbil Road	Ogunbil	Tamworth Regional	LGOV
Old Baker and Residence	62 Attunga Street	Attunga	Tamworth Regional	LGOV
Old Church Boutique	92 Jenkins Street	Nundle	Tamworth Regional	LGOV
Old Convent Building	223-227 Marius Street	Tamworth	Tamworth Regional	LGOV
Old Cottage (To rear of Trainview WOO-008)	Daisy Street	Woolbrook	Tamworth Regional	LGOV
Old Courthouse Building	212 Peel Street	Tamworth	Tamworth Regional	LGOV
Old Courthouse Kitchen	Frappell Street	Weabonga	Tamworth Regional	LGOV
Old Flour Mill	175-179 Peel Street	Tamworth	Tamworth Regional	LGOV
Old Gowrie School Site	Gowrie Road	Gowrie	Tamworth Regional	LGOV
Old Hotel Building	143-145 Marius Street	Tamworth	Tamworth Regional	LGOV
Old Piallamore School Residence	Nundle Road	Piallamore	Tamworth Regional	LGOV
Old Post Office, Glenlui	1265 Manilla Road	Hallsville	Tamworth Regional	LGOV
Old School	Bithramere Lane	Bithramere	Tamworth Regional	LGOV
Old St. Joseph's School Site (Site Plan also indicating relationship between old	Nundle Road	Dungowan	Tamworth Regional	LGOV
Original Bendemeer Post Office (Former)	99-102 Caroline Street	Bendemeer	Tamworth Regional	LGOV
Original building	Court Street	Manilla	Tamworth Regional	SGOV
Original Manilla Hospital Building	Court Street	Manilla	Tamworth Regional	LGOV
Oxley Memorial Anchor	Manilla Road (Corner)	Hallsville	Tamworth Regional	LGOV
Peel Inn	89 Jenkins Street	Nundle	Tamworth Regional	LGOV
Police Station (Former)	40 Attunga Street	Attunga	Tamworth Regional	LGOV
Port Stephens Cutting, Hand Laid Stone	Nowendoc Road	Niangala	Tamworth Regional	LGOV
Post Office	402A Peel Street	Tamworth	Tamworth Regional	LGOV
Post Office Hotel	146 Manilla Street	Manilla	Tamworth Regional	LGOV
Power House Motel	248 Marius Street	Tamworth	Tamworth Regional	LGOV
Quirindi Courthouse	George Street	Quirindi	Tamworth Regional	SGOV
Railway Bridge	Peel Street	Tamworth	Tamworth Regional	LGOV
Railway House	20 Darling Street	Tamworth	Tamworth Regional	LGOV
Regent Cinema	3-5 Brisbane Street	Tamworth	Tamworth Regional	LGOV
Residence	72 Caroline Street	Bendemeer	Tamworth Regional	LGOV
Residence	50 Caroline Street	Bendemeer	Tamworth Regional	LGOV
Residence	14 Hill Street	Manilla	Tamworth Regional	LGOV
Residence	194-196 Manilla Street	Manilla	Tamworth Regional	LGOV
Residence	48 Queen Street	Barraba	Tamworth Regional	LGOV
Residence	92 Court Street	Manilla	Tamworth Regional	LGOV
Residence	94 Court Street	Manilla	Tamworth Regional	LGOV
Residence	105 Court Street	Manilla	Tamworth Regional	LGOV
Residence	113 Court Street	Manilla	Tamworth Regional	LGOV
Residence	78 Court Street	Manilla	Tamworth Regional	LGOV
Residence	57 Strafford Street	Manilla	Tamworth Regional	LGOV
Residence	751 Barry Road	Hanging Rock	Tamworth Regional	LGOV
Residence	5 Hill Street	Manilla	Tamworth Regional	LGOV
Residence	8 Hill Street	Manilla	Tamworth Regional	LGOV
Residence	272 Manilla Street	Manilla	Tamworth Regional	LGOV
Residence	Ratcliffe Avenue	Manilla	Tamworth Regional	LGOV
Residence	79 Jenkins Street	Nundle	Tamworth Regional	LGOV
Residence	25 Cooper Street	Barraba	Tamworth Regional	LGOV

Residence	11 Alice Street	Barraba	Tamworth Regional	LGOV
Residence	34 Maude Street	Barraba	Tamworth Regional	LGOV
Residence	38 Maude Street	Barraba	Tamworth Regional	LGOV
Residence	97 Fitzroy Street	Barraba	Tamworth Regional	LGOV
Residence	98 River Street	Manilla	Tamworth Regional	LGOV
Residence	63 Fitzroy Street	Barraba	Tamworth Regional	LGOV
Residence	53 Fitzroy Street	Barraba	Tamworth Regional	LGOV
Residence	24 Alice Street	Barraba	Tamworth Regional	LGOV
Residence	29 Rodney Street	Barraba	Tamworth Regional	LGOV
Residence	31 Henry Street	Barraba	Tamworth Regional	LGOV
Residence	55 Edward Street	Barraba	Tamworth Regional	LGOV
Residence	26 Savoy Street	Barraba	Tamworth Regional	LGOV
Residence	67 Namoi Street	Manilla	Tamworth Regional	LGOV
Residence	73 Namoi Street	Manilla	Tamworth Regional	LGOV
Residence	96 Arthur Street	Manilla	Tamworth Regional	LGOV
Residence	94 Arthur Street	Manilla	Tamworth Regional	LGOV
Residence	227 Manilla Street	Manilla	Tamworth Regional	LGOV
Residence	50 Strafford Street	Manilla	Tamworth Regional	LGOV
Residence	80 Rowan Street	Manilla	Tamworth Regional	LGOV
Residence	42 Strafford Street	Manilla	Tamworth Regional	LGOV
Residence	94 Rowan Street	Manilla	Tamworth Regional	LGOV
Residence	106 Rowan Street	Manilla	Tamworth Regional	LGOV
Residence	64 Namoi Street	Manilla	Tamworth Regional	LGOV
Residence	104 Namoi Street	Manilla	Tamworth Regional	LGOV
Residence	125 Manilla Street	Manilla	Tamworth Regional	LGOV
Residence	119-121 Manilla Street	Manilla	Tamworth Regional	LGOV
Residence	69 Cherry St	Barraba	Tamworth Regional	LGOV
Residence	86-88 Nundle Road	Woolomin	Tamworth Regional	LGOV
Residence	Munroo Street	Woolomin	Tamworth Regional	LGOV
Residence	83 River Street	Manilla	Tamworth Regional	LGOV
Residence	44 Market Street	Manilla	Tamworth Regional	LGOV
Residence	78 Strafford Street	Manilla	Tamworth Regional	LGOV
Residence	79 Strafford Street	Manilla	Tamworth Regional	LGOV
Residence	68 Strafford Street	Manilla	Tamworth Regional	LGOV
Residence	43 Gotha Street	Barraba	Tamworth Regional	LGOV
Residence	67 Strafford Street	Manilla	Tamworth Regional	LGOV
Residence - Police Station	62 Manilla Street	Manilla	Tamworth Regional	LGOV
Residence - The Church	Gowrie Road	Gowrie	Tamworth Regional	LGOV
Residence 'Avonlea'	13 Railway Parade	Manilla	Tamworth Regional	LGOV
Residence 'Mayvale'	Mayvale, Rushes Creek Road	Manilla	Tamworth Regional	LGOV
Residence 'Ngundi'	64 Rowan Street	Manilla	Tamworth Regional	LGOV
Retreat Main House	Kingstown Road	Retreat	Tamworth Regional	LGOV
Retreat Old Granite Store	Kingstown Road	Retreat	Tamworth Regional	LGOV
Riverview - Residence	14 Singh Street	Woolbrook	Tamworth Regional	LGOV
Roman Catholic Church	Ridge Street	Attunga	Tamworth Regional	LGOV
Royal Hotel	153-159 Manilla Street	Manilla	Tamworth Regional	LGOV
Royce Cottage	197 Manilla Street	Manilla	Tamworth Regional	LGOV
School Residence	327 Meldom Lane	Hallsville	Tamworth Regional	LGOV
Scout Hall	Strafford Street	Manilla	Tamworth Regional	LGOV
Service Station	73 Queen Street	Barraba	Tamworth Regional	LGOV
Sheba Dam Gatekeeper's Slab Cottage	Barry Road Sheba Dam	Hanging Rock	Tamworth Regional	LGOV
Shop	83 Queen Street	Barraba	Tamworth Regional	LGOV
Shop	99 Queen Street	Barraba	Tamworth Regional	LGOV
Shop	92-94 Queen Street	Barraba	Tamworth Regional	LGOV
Shop	200 Manilla Street	Manilla	Tamworth Regional	LGOV
Shop	277 Peel Street	Tamworth	Tamworth Regional	LGOV
Shop	79 Queen Street	Barraba	Tamworth Regional	LGOV
Shop	265-267 Peel Street	Tamworth	Tamworth Regional	LGOV
Shop and Library	102-108 Queen Street	Barraba	Tamworth Regional	LGOV
Shopfront Glass	78-80 Brisbane Street	Tamworth	Tamworth Regional	LGOV
Shops	465-469 Peel Street	Tamworth	Tamworth Regional	LGOV
Shops	103-105 Manilla Street	Manilla	Tamworth Regional	LGOV
Silverweir Homestead	Appleby Lane	Appleby	Tamworth Regional	LGOV
Slab Hut	Bloomfield Street	Somerton	Tamworth Regional	LGOV
Slab Hut near Calala	138-144 Denison Street	Tamworth	Tamworth Regional	LGOV
Somerton Cemetery	Being Point	Somerton	Tamworth Regional	LGOV
Somerton Police Station	Bloomfield Street	Somerton	Tamworth Regional	LGOV
Somerton Post Office and General Store (Former)	Scotland Street	Somerton	Tamworth Regional	LGOV
Somerton Public School	Milkmaid Streets (Corner)	Somerton	Tamworth Regional	LGOV
Somerton Racecourse	Racecourse Road	Somerton	Tamworth Regional	LGOV
Somerton War Memorial Hall	Scotland Street (Corner)	Somerton	Tamworth Regional	LGOV
Split Rock Dam	Manilla River	Manilla	Tamworth Regional	SGOV
St Andrews Anglican Church	Denman Avenue (Corner)	Kootingal	Tamworth Regional	LGOV
St Andrews Church	152-154 Marius Street	Tamworth	Tamworth Regional	LGOV
St Andrews Presbyterian Church	Rowan Street	Manilla	Tamworth Regional	LGOV
St Joseph's Catholic Convent (Former)	Nundle Road	Dungowan	Tamworth Regional	LGOV
St Martins Anglican Church	Nundle Road	Piallamore	Tamworth Regional	LGOV
St Nicholas Church	18 White Street	Tamworth	Tamworth Regional	LGOV
St. Johns Anglican Parish	Woodsreef Road	Woodsreef	Tamworth Regional	LGOV
St. John's Catholic Church Hall and Residence	58-64 Fitzroy Street	Barraba	Tamworth Regional	LGOV
St. John's Church	102 Carthage Street	Tamworth	Tamworth Regional	LGOV
St. Laurence's Church of England, Church Vicarage, Parish Hall	52-54 Fitzroy Street	Barraba	Tamworth Regional	LGOV

St. Luke's Uniting Church	Sandy Road (Corner)	Kootingal	Tamworth Regional	LGOV
St. Mark's Anglican Church	Scotland Street	Somerton	Tamworth Regional	LGOV
St. Mary's Anglican Church	50-52 Frederick Street	Woolomin	Tamworth Regional	LGOV
St. Mathew's Presbyterian Church	Scotland Road	Somerton	Tamworth Regional	LGOV
St. Michaels Church (Roman Catholic)	Nundle Road	Dungowan	Tamworth Regional	LGOV
St. Paul's Church	63 Bridge Street	West Tamworth	Tamworth Regional	LGOV
St. Peter's Catholic Church	15 Innes Street	Nundle	Tamworth Regional	LGOV
St. Stevens Anglican Church	Caroline Street	Bendemeer	Tamworth Regional	LGOV
St. Thomas Anglican Church	Nowendoc Road	Dungowan	Tamworth Regional	LGOV
Stratharlie	Oxley Highway West	Somerton	Tamworth Regional	LGOV
Sulcor Limestone Mine Kilns	Sulcor Road	Attunga	Tamworth Regional	LGOV
Tamworth Centre for Crop Improvement	Calala Lane	Tamworth	Tamworth Regional	SGOV
Tamworth Correctional Centre	Dean Street, corner 154 Johnston Street	Tamworth	Tamworth Regional	SGOV
Tamworth Correctional Centre	152-160 Johnston Street	Tamworth	Tamworth Regional	LGOV
Tamworth Correctional Centre - Administration	Dean Street, corner 154 Johnston Street	Tamworth	Tamworth Regional	SGOV
Tamworth Correctional Centre - Cell Block	Dean Street, corner 154 Johnston Street	Tamworth	Tamworth Regional	SGOV
Tamworth Correctional Centre - Dry Cell	Dean Street, corner 154 Johnston Street	Tamworth	Tamworth Regional	SGOV
Tamworth Correctional Centre - Gatehouse & Visitors	Dean Street, corner 154 Johnston Street	Tamworth	Tamworth Regional	SGOV
Tamworth Correctional Centre - Internal Administration Buildings	Dean Street, corner 154 Johnston Street	Tamworth	Tamworth Regional	SGOV
Tamworth Correctional Centre - Walls & Towers	Dean Street, corner 154 Johnston Street	Tamworth	Tamworth Regional	SGOV
Tamworth Court House	Marius and Fitzroy Street	Tamworth	Tamworth Regional	SGOV
Tamworth East Zone Substation	Cockburn Street	Tamworth	Tamworth Regional	SGOV
Tamworth Gatekeeper's residence	20 Darling Street	Tamworth	Tamworth Regional	SGOV
Tamworth Hotel	147 Marius Street	Tamworth	Tamworth Regional	LGOV
Tamworth House	34 Bourke Street	North Tamworth	Tamworth Regional	LGOV
Tamworth Primary School and Residence	Upper Street	Tamworth	Tamworth Regional	LGOV
Tamworth Railway Footbridge	455.040km Northern Railway Line, Bourke Street	Tamworth	Tamworth Regional	SGOV
Tamworth Railway Station	Marius Street	Tamworth	Tamworth Regional	SGOV
Tamworth Railway Station	100 Brisbane Street	Tamworth	Tamworth Regional	LGOV
Tamworth, Former Station Master's Residence	34 Bourke Street	Tamworth	Tamworth Regional	SGOV
Tamworth, Peel River Underbridge	454.125km Northern Railway Line	Tamworth	Tamworth Regional	SGOV
Tamworth, Peel Street Underbridge	454.187km Northern Line, Peel Street	Tamworth	Tamworth Regional	SGOV
Tarpoly Creek Railway Bridge	Main Road 63	Barraba	Tamworth Regional	LGOV
The Claypan and Fuller Gallery	74 Queen Street	Barraba	Tamworth Regional	LGOV
Timber Bridge over Macdonald River	Havannah Street	Bendemeer	Tamworth Regional	LGOV
Timbumburi School	RMB 539 New England Highway South	Timbumburi	Tamworth Regional	LGOV
Tintinhull Public School	Tintinhull Road	Tintinhull	Tamworth Regional	LGOV
Tobacco Kiln	73-95 King George Avenue	Tamworth	Tamworth Regional	LGOV
Tobacco Kiln	119-139 King George Avenue	Tamworth	Tamworth Regional	LGOV
Tobacco Kiln	Scott Road	Tamworth	Tamworth Regional	LGOV
Town Hall	26-28 Fitzroy Street	Tamworth	Tamworth Regional	LGOV
Trainview - Residence	Back Woolbrook Road	Woodsreef	Tamworth Regional	LGOV
Treloar Building	85-87 Queen Street	Barraba	Tamworth Regional	LGOV
Tyrone Residence	10 Limbri Road	Kootingal	Tamworth Regional	LGOV
Uniting Church	53-55 Queen Street	Barraba	Tamworth Regional	LGOV
Uniting Church	Strafford Street	Manilla	Tamworth Regional	LGOV
Uniting Church Hall	Strafford Street	Manilla	Tamworth Regional	LGOV
Upper Manilla, Borah Creek Underbridge	516.834km, West Tamworth To Barraba Railway	Upper Manilla	Tamworth Regional	SGOV
Victoria Hotel	82 Queen Street	Barraba	Tamworth Regional	LGOV
Walcha Courthouse	Apsley Street	Walcha	Tamworth Regional	SGOV
War Memorial	Gipps Street	Tamworth	Tamworth Regional	LGOV
Weabonga Cemetery	Weabonga Road	Weabonga	Tamworth Regional	LGOV
Weabonga Hall	Mitchell Street	Weabonga	Tamworth Regional	LGOV
Weabonga School	Mitchell Street Mitchell Street Mitchell Street	Weabonga	Tamworth Regional	LGOV
Wells	Scott Road	Tamworth	Tamworth Regional	LGOV
Wells and Pumping Station off Peel River	Scott Road	Tamworth	Tamworth Regional	LGOV
Wesleyan Church and House	144 Marius Street	Tamworth	Tamworth Regional	LGOV
West Retreat	Longford Retreat Road	Retreat	Tamworth Regional	LGOV
West Retreat Bridge	Retreat Road	Retreat	Tamworth Regional	LGOV
West Tamworth Railway Station	In and Outs Streets	West Tamworth	Tamworth Regional	LGOV
West Tamworth Railway Station	In Street	West Tamworth	Tamworth Regional	SGOV
Western Railway Viaduct	Peel Street	Tamworth	Tamworth Regional	LGOV
Winton Cemetery	Old Winton Road	Winton	Tamworth Regional	LGOV
Wold's Buildings	84-88 Queen Street	Barraba	Tamworth Regional	LGOV
Woodsreef Cemetery	Old Bundarra Road	Woodsreef	Tamworth Regional	LGOV
Woolbrook War Memorial Hall	Limbri-woolbrook Road	Woolbrook	Tamworth Regional	LGOV
Wyaralong Homestead	Manilla Road	Attunga	Tamworth Regional	LGOV
Yaccamunda - Airlie Station	Property - Airlie Station Rocky Gully Road	Bendemeer	Tamworth Regional	LGOV
Yarramanbully School Building	197 Manilla Street	Manilla	Tamworth Regional	LGOV
Yellow Box Stand	Calala Lane	Tamworth	Tamworth Regional	SGOV

There was a total of 545 records matching your search criteria.

Tamworth Regional Local Environmental Plan 2010

Current version for 15 January 2020 to date (accessed 26 February 2020 at 10:55)

Schedule 5

Schedule 5 Environmental heritage

(Clause 5.10)

Locality	Item name	Address	Property description	Significance	Item no
Appleby	"Matilda Park"	Appleby Lane	Corner Lot 12, DP 850174	Local	I001
Appleby	"Silverweir"	Appleby Lane	Lots 1 and 2, DP 162586	Local	I002
Attunga	Attunga Hall	Attunga Street	Part Lot 16, DP 728377	Local	I003
Attunga	Attunga Silos	Attunga Street	Lot 1, DP 814784	Local	I004
Attunga	Attunga Youth Hall	11–15 Attunga Street	Lots 6–8, Sec 7, DP 758039	Local	I006
Attunga	"Innes Cottage"	23 Attunga Street	Lot 2, Sec 7, DP 758039	Local	I007
Attunga	Old Police Station	40 Attunga Street	Lot 1, Sec 1, DP 758039	Local	I009
Attunga	Old Bakery and Residence	62 Attunga Street	Lot 4, DP 4927	Local	I010
Attunga	"Wyaralong" Homestead	Manilla Road	Lot 102, DP 715168; Lot 2, DP 226084	Local	I012
Attunga	Attunga Hotel	1–3 Manilla Road	Lots 7 and 8, Sec 4, DP 758039	Local	I013
Attunga	Attunga Cemetery	Ridge Street	Lots 10–14, DP 114775; unnumbered lots, DP 753834	Local	I014
Attunga	Christ Church Anglican	Ridge Street	Lot 12, DP 635002; Lot 269, DP 758039	Local	I015
Attunga	Roman Catholic Church	Ridge Street	Corner Lot 9, Sec 2, DP 758039	Local	I016
Attunga	Sulcor Limestone Mine Kilns	Sulcor Road	Lot A, DP 398256; Lot 1, DP 187223; Lot 1, DP 312169; Lots 1 and 2, DP 559907; Lot 10, DP 706592	Local	I017
Barraba	Residence	11 Alice Street	Lot 1, DP 80632	Local	I018

Barraba	Residence	24 Alice Street	Lot 1, Sec 9, DP 758059	Local	I019
Barraba	Residence	69 Cherry Street	Lot 10, DP 667567	Local	I020
Barraba	Residence	25 Cooper Street	Lot 1, DP 238800; Lot 1, DP 546390	Local	I021
Barraba	"Ivanhoe" Residence	37 Edward Street	Lots 102 and 104, DP 608118	Local	I022
Barraba	Residence	55 Edward Street	Lot 5, DP 238577	Local	I023
Barraba	Barraba Senior Citizens Centre	50 Fitzroy Street	Lot 1, DP 67137; Lot 1, DP 156909; Lot 2, DP 515755	Local	I024
Barraba	St Laurence's Church of England, Church Vicarage, Parish Hall	52–54 Fitzroy Street	Part Lots 15 and 16; Lots 17–19, Sec 9, DP 758059; Lot A, DP 404169	Local	I025
Barraba	Residence	53 Fitzroy Street	Lot 1, DP 798695; Lot A, DP 931678	Local	I026
Barraba	St John's Catholic Church, Hall and Residence	58–64 Fitzroy Street	Lots 17–19, Sec 5, DP 758059	Local	I027
Barraba	Residence	63 Fitzroy Street	Lot 1, DP 4118	Local	I028
Barraba	Residence	97 Fitzroy Street	Lot 3, DP 70849	Local	I029
Barraba	Barraba District Hospital	Gotha Street	Lot 1, DP 114837; Lots 1–3, DP 618268; Lots 12–15 and 18, Sec 16, DP 758059	Local	I030
Barraba	Barraba Primary School	Gotha Street	Lot 188, DP 729694	Local	I031
Barraba	Residence	43 Gotha Street	Lot 10, Sec 7, DP 758059	Local	I032
Barraba	Residence	31 Henry Street	Lot B, DP 328629	Local	I034
Barraba	Tarpoly Creek Railway Bridge	Main Road 63—20.25km south of Barraba	Lot 7009, DP 1056182	Local	I035
Barraba	Residence	34 Maude Street	Lot 1, DP 405116; Lot 8, Sec 6, DP 758059	Local	I036
Barraba	Residence	38 Maude Street	Lot 6, Sec 6, DP 758059	Local	I037
Barraba	Barraba Showground and Racecourse	Mulwaree Road	Lot 8, DP 258804; Lots 233 and 234, DP 577664; Lot 71, DP 606756	Local	I038

Barraba	Great War Memorial (clock tower)	Queen and Maude Streets intersection	Road Segment No 135277	Local	I039
Barraba	Residence	48 Queen Street	Lot 17, Sec 18, DP 758059	Local	I040
Barraba	Uniting Church	53–55 Queen Street	Lot 12, DP 576670	Local	I041
Barraba	Nandewar Historical Society Building	71 Queen Street	Lot 2, DP 583209	Local	I042
Barraba	Service Station	73 Queen Street	Lot 1, DP 580054; Lot 1, DP 583209	Local	I043
Barraba	The Claypan & Fuller Gallery	74 Queen Street	Lots A–C, DP 161796	Local	I044
Barraba	Shop	79 Queen Street	Lot C, DP 390775	Local	I045
Barraba	Victoria Hotel	82 Queen Street	Lot 1, DP 555447	Local	I046
Barraba	Shop	83 Queen Street	Lot 1, DP 228573	Local	I047
Barraba	Wold's Buildings	84–88 Queen Street	Lot 1, DP 199605	Local	I048
Barraba	Treloar Building	85–87 Queen Street	Lots 2 and 3, DP 228573	Local	I049
Barraba	Shop	92 Queen Street	Part Lot 103, DP 853536	Local	I050
Barraba	Shop	99 Queen Street	Lot 92, DP 802301	Local	I051
Barraba	Clifton Hall	100 Queen Street	Lot 2, DP 301428	Local	I052
Barraba	Shop and library	102 and 108 Queen Street	Lot 1, DP 301428; Lot B, DP 307344; Lots 1 and 2, DP 22936	Local	I053
Barraba	Jacob's Building (Barraba Information Centre)	114–116 Queen Street	Lot 5, DP 22936	Local	I054
Barraba	Hotel	121 Queen Street	Lot 1, DP 195910; Lot 2, DP 81384	Local	I055
Barraba	Former Court House	127 Queen Street	Part Lot 6, Sec 5, DP 758059	Local	I056
Barraba	Bank	129 Queen Street	Lot 7, DP 137242	Local	I057
Barraba	Commercial Hotel	136 Queen Street	Lot 1, DP 205458	Local	I059
Barraba	Residence	29 Rodney Street	Lot C, DP 942620	Local	I060
Barraba	Morrow's Row (residence)	1–3 Savoy Street	Lot 11, Sec 4, DP 758059	Local	I061
Barraba	Morrow's Row (residence)	5 Savoy Street	Lot 9, DP 38154	Local	I062
Barraba	Morrow's Row (residence)	7 Savoy Street	Lot 8, DP 38154	Local	I063

Barraba	Morrow's Row (residence)	9 Savoy Street	Lot 7, DP 38154	Local	I064
Barraba	Morrow's Row (residence)	11 Savoy Street	Lot 6, DP 38154	Local	I065
Barraba	Morrow's Row (residence)	13 Savoy Street	Lot 5, DP 38154	Local	I066
Barraba	Morrow's Row (residence)	15 Savoy Street	Lot 4, DP 38154	Local	I067
Barraba	Morrow's Row (residence)	17 Savoy Street	Lot 3, DP 38154	Local	I068
Barraba	Morrow's Row (residence)	19 Savoy Street	Lot 2, DP 38154	Local	I069
Barraba	Morrow's Row (residence)	21 Savoy Street	Lot 1, DP 38154	Local	I070
Barraba	Residence	26 Savoy Street	Lot 2, DP 219840	Local	I071
Barraba	Barraba Cemetery	West Street	R 63304	Local	I073
Barraba	"Angelsea" Residence	Woodsreef Road	Lots 7 and 8, DP 114267; Part Lots 43 and 53, Lots 60, 61, 56, 66 and 79, DP 752200	Local	I074
Bective	"Bon Accord"	Corner Appleby Lane and Oxley Highway	Lot 13, DP 849425	Local	I075
Bective	Bective Station	Bective Station Oxley Highway	Lots 7–11, 14–17, 19, 32, 37, 44, 50–56, 74–77, 88–92, 96, 97, 116, 117, 157, 158, 172, 179 and 189, and Part Lots 13 and 33, DP 753833; Lots 1–3, DP 127874; Lots 1–6, DP 127895; Lot 1, DP 205381	Local	I076
Bective	Brigalow Reserve	Bective Station Oxley Highway Reserve No 200016	Lot 1, DP 128153; Lot 14, DP 127893; Lot 186, DP 755319; Lot 7, DP 127893; Lot 7003, DP 1028534; Lot 7004, DP 1028534	Local	I077
Bendemeer	"Airlie" Station House, "Airlie" Station Woolshed	Airlie Station Road	Lots 52, 72, 97, 98 and 103–109, DP 753831	Local	I078
Bendemeer	St Stephen's Anglican Church	Caroline Street	Corner Lot 1, Sec 19, DP 758090	Local	I080

Bendemeer	Bendemeer Cemetery	Caroline Street	Lots 3, 4, 7, 8, 10 and 11, DP 264250; Lots 1–3, Sec 35 and Lots 1–5, Sec 36, DP 758090	Local	I081
Bendemeer	Residence	50 Caroline Street	Lot 11, DP 817466	Local	I082
Bendemeer	Residence	72 Caroline Street	Lot 8, Sec 21, DP 758090	Local	I083
Bendemeer	Bendemeer Hall	87–89 Caroline Street	Lots 18 and 19, Sec 19, DP 758090	Local	I084
Bendemeer	Former Bendemeer Post Office	99–102 Caroline Street	Lots 4 and 5, Sec 23, DP 758090	Local	I085
Bendemeer	General Store and Stable	109–111 Caroline Street	Lots 14 and 15, Sec 17, DP 758090	Local	I079
Bendemeer	Bendemeer Hotel	112–130 Caroline Street	Lots 1–10, Sec 24, DP 758090	Local	I086
Bendemeer	Former Bendemeer Butchery and Residence	113–115 Caroline Street	Lot 13, Sec 17, DP 758090	Local	I087
Bendemeer	Church	135–139 Caroline Street	Lots 8–11, Sec 16, DP 758090	Local	I088
Bendemeer	Bendemeer Cafe	141–143 Caroline Street	Lots 15–18, Sec 15, DP 758090	Local	I089
Bendemeer	Blair Graves	155 Caroline Street	Lots 8 and 9, Sec 15, DP 758090	Local	I090
Bendemeer	Bendemeer Police Station	157 Caroline Street	Lot 702, DP 1125520	Local	I091
Bendemeer	Bendemeer Public School	Charles Street	Lots 234 and 235, DP 729430	Local	I092
Bendemeer	Timber Bridge over Macdonald River	Havannah Street		Local	I093
Bendemeer	“Haning” and “Haning” Graveyard	Longford Retreat Road	Lots 2–5, 15, 16, 20–23, 26–28, 30–32, 45 and 104–105, Part Portion 29, DP 753839; Lots 3–8, DP 251609	Local	I094
Bendemeer	“Longford Station”	Longford Retreat Road	Lots 2, 4, 9, 10, 12–17, 19, 33–35, 38, 39, 41, 44–47, 50, 53, 88, 93, 94, 120 and 124, Part Portions 48 and 49, DP 753850; Lot 1, DP 778828	Local	I095

Bendemeer	"Bendemeer" Station, "Bendemeer" Station Graves, "Bendemeer" Station Woolshed	New England Highway	Lot 2, DP 156594	Local	I096
Bendemeer	"Yaccamunda"	Rocky Gully Road	Lot 1, DP 1101440	Local	I097
Bithramere	Old School	Bithramere Lane	Lot 44, DP 548924	Local	I098
Bowling Alley Point	Bowling Alley Point Cemetery	Anderson's Flats	Lot 7013, DP 96292	Local	I099
Bowling Alley Point	Bowling Alley Point School	Bowling Alley Point	Lot 56, DP 755324	Local	I100
Bowling Alley Point	Iron Footbridge	Recreation Reserve Chaffey Dam	Within DP 755324	Local	I101
Bowling Alley Point	Uniting Church	River Road	Lot 41, DP 755324	Local	I102
Bowling Alley Point	Bowling Alley Point Geological Site	River Road	Lot 282, DP 755324	Local	I103
Daruka	Daruka Station	80 Wyndham Close	Lot 200, DP 1040669	Local	I104
Dungowan	Dungowan Store and Bakery	Nundle Road	Part Portion 22, DP 755337; Lot 1, DP 254341	Local	I106
Dungowan	Former Butchery	Nundle Road	Lot 1, DP 375009	Local	I108
Dungowan	Former Manvell's Bakery	Nundle Road	Lot 1, DP 307297	Local	I109
Dungowan	Roman Catholic Church, former Catholic Convent, former Catholic School Site	Nundle Road	Lot 2, DP 24002; Lot 1, DP 950284	Local	I110
Dungowan	Dungowan Cemetery	Ogunbil Road	Lot 139, DP 755337	Local	I111
Dungowan	Dungowan Memorial Hall	Ogunbil Road	Lot 35, DP 755337	Local	I112
Dungowan	St Thomas' Anglican Church	Ogunbil Road	Lot 143, DP 755337	Local	I113
Dungowan	Dungowan Public School	137 Ogunbil Road	Lots 1 and 38, DP 755337	Local	I114
Duri	Duri Silos	Duri Street	Lot 1, DP 819872	Local	I116
Duri	Duri Community Hall	2 Duri Street	Lots 6–8, Sec 13, DP 758368	Local	I117
Duri	Former Catholic Church	Corner Tangaratta Street and Warral Road	Corner Lot 5, Sec 10, DP 758368	Local	I120
Garthowen	"Glenview"	Garthowen Road	Lot 1, DP 957571	Local	I123
Gidley	Gidley Silos	968 Wallamore Road	Lot 1, DP 819859	Local	I124

Goonoo Goonoo	Goonoo Goonoo Homestead and Associated Outbuildings, Shearing Shed, The Inn, The Graves, The Chapel, Cottage Number 1—The Cook's House, Cottage Number 2—The Jackaroo's Quarters, Cottage Numbers 3, 4, 5, 7, 8, 9, 10, 11, Shearer's Quarters, Stables, Farrier's Shed, Car Shed, Machinery Shed, Machine Workshop, Smoko Room, Office, Main Homestead, Dairy, Stone Store and Post Office, Cool Room, Tack Room, The Church	New England Highway via Tamworth	Lot 1, DP 1102382; Lot 64, DP 755343	Local	I125
Gowrie	"The Church"	Gowrie Road	Lot 191, DP 755327	Local	I126
Gowrie	Old Gowrie School	Sweenys Lane	Lots 203 and 204, DP 39485	Local	I127
Hallsville	Former Hallsville Hall	Manilla Road	Lot 48, DP 753851	Local	I128
Hallsville	Former School	Manilla Road	Lot 2, DP 48671	Local	I129
Hallsville	Methodist Church and Cemetery	Manilla Road	Lots 2 and 3, DP 164098; Lot 1, DP 195874	Local	I130
Hallsville	Oxley Memorial Anchor	Corner Manilla and Anchor Roads (Public Reserve)	Lots 22 and 23, DP 240530	Local	I131
Hallsville	Old Post Office, "Glenlui"	1265 Manilla Road	Lot 3, DP 231618	Local	I132
Hallsville	School Residence	327 Meldorn Lane	Lot 1, DP 48671	Local	I133
Hanging Rock	Black Snake Gold Mine	Barry Road	Lot 440, DP 822503	Local	I134
Hanging Rock	Sheba Dam Gatekeeper's Slab Cottage	Barry Road, Sheba Dam	Lot 7003, DP 96506	Local	I135
Hanging Rock	Residence	751 Barry Road	Lot 4, DP 626927	Local	I136
Hanging Rock	Hanging Rock Historic Cemetery	Forest Way	Lot 7002, DP 1030465	Local	I137
Kootingal	Limbri Church	Church Street	Lot 80, DP 791481	Local	I139

Kootingal	Former Limbri Store and Post Office	3 Church Street	Lots 77 and 120, DP 753837	Local	I140
Kootingal	Moonby House, Out House and Graves	52 Churchill Drive, Moonbi	Lot 4, DP 706876; Lots 78 and 79, DP 37123	State	I141
Kootingal	Kootingal Police Station	Denman Avenue	Lot 261, DP 753841	Local	I142
Kootingal	Kootingal School	Denman Avenue	Lots 199 and 210, DP 758584; Lot 283, DP 821670	Local	I143
Kootingal	War Memorial—Memorial Park	Denman Avenue	Lots 1 and 2, Sec 2, DP 758584	Local	I144
Kootingal	St Luke's Uniting Church	Corner Denman Avenue and Sandy Roads	Lot 14, Sec 1, DP 758584	Local	I146
Kootingal	St Andrew's Anglican Church	Corner Gate Street and Denman Avenue	Lots 1 and 2, DP 597443	Local	I147
Kootingal	Kootingal Gate House	Gate Street	Lot 1, DP 814708	Local	I148
Kootingal	Kootingal Hotel	18–20 Gate Street	Lot 41, DP 5695	Local	I149
Kootingal	Limbri Gatehouse	Corner Limbri Road and Mulla Creek Road	Lot 44, DP 846377	Local	I152
Kootingal	Limbri School	Limbri Road	Lot 1, DP 1089996	Local	I155
Kootingal	"Tyrone" Residence	10 Limbri Road	Lots 108–113 and 132–135, DP 753837	Local	I156
Kootingal	"Kissing Gate"	Railway Land—Limbri Village		Local	I154
Loomberah	Loomberah War Memorial Hall	Corner Duri and Dungowan Roads	Lot 273, DP 587455	Local	I157
Manilla	Manilla Central School	Arthur Street	Lot 204, DP 752191	Local	I158
Manilla	Residence	94 Arthur Street	Lot 1, DP 313167; Lot 1, DP 329932	Local	I159
Manilla	Residence	96 Arthur Street	Lots 180 and 181, DP 758644; Lot C, DP 101081	Local	I160
Manilla	The Sunken Dairy on the property known as "Buena Vista"	Buena Vista Road	Lots 1–3, DP 722207; Lots 8, 9, 15, 47–50, 92, 96 and 97, DP 752199; Part Lot 12 and Lots 15, 17–19, 35 and 36, DP 752204	Local	I161

Manilla	Factory	Court Street	Lot 22, DP 554245	Local	I162
Manilla	Manilla RSL	Court Street	Lot 21, DP 554245	Local	I163
Manilla	Original Manilla Hospital Building	Court Street	Lot 14, DP 814059	Local	I164
Manilla	St Michael's Catholic Church	Court Street	Lots 189 and 192, DP 752191; Lot 10, DP 1002217	Local	I165
Manilla	Residence/Police Station	Court Street	Lot 701, DP 93885	Local	I174
Manilla	Manilla Masonic Centre	56 Court Street	Lot D, DP 3681	Local	I166
Manilla	Girl Guides Manilla	68 Court Street	Lot B, DP 102992	Local	I167
Manilla	Residence	78 Court Street	Lot 1, DP 577480	Local	I168
Manilla	Residence	92 Court Street	Lot 9, Sec 3, DP 5787	Local	I169
Manilla	Residence	94 Court Street	Lot 10, Sec 3, DP 5787	Local	I170
Manilla	Grantham's Stone Bridge	102–106 Court Street	Lot 2, DP 564484	Local	I171
Manilla	Residence	105 Court Street	Lot 2, DP 736232	Local	I172
Manilla	Residence	113 Court Street	Lots 1 and 2, DP 619206	Local	I173
Manilla	Residence	5 Hill Street	Lot 6, Sec 2, DP 5787	Local	I175
Manilla	Residence	8 Hill Street	Lot 151, DP 546573	Local	I176
Manilla	Holy Trinity Anglican Church	10 Hill Street	Lots 19 and 20, Sec 1, DP 5787	Local	I177
Manilla	Residence	14 Hill Street	Lot 18, Sec 1, DP 5787	Local	I178
Manilla	Upper Manilla Road Bridge	Main Road 63		Local	I180
Manilla	Manilla St Clock	Centre Manilla and Strafford Streets intersection	Manilla Strafford Road Segment No 130369	Local	I181
Manilla	German Machine Gun and Russian Canon (Memorial) Rotary Park	Manilla Street	Lot 7, DP 664044; Lot 6, Sec 24, DP 758644	Local	I182
Manilla	Manilla Courthouse	64 Manilla Street	Part Reserve 12927	Local	I184
Manilla	Courthouse Hotel	85 Manilla Street	Lot 1, DP 920421	Local	I185
Manilla	Shops	103 Manilla Street	Part Lot B, DP 384820	Local	I186

Manilla	Residence	119–121 Manilla Street	Lot 1, DP 310250	Local	I187
Manilla	Residence	127 Manilla Street	Lot 1, DP 3458; Lot 1, DP 1101836	Local	I188
Manilla	Post Office Hotel	146 Manilla Street	Lot 11, DP 604620	Local	I189
Manilla	Bank of New South Wales Building	147 Manilla Street	Lot A, DP 928271	Local	I190
Manilla	Royal Hotel	153–159 Manilla Street	Part Lot 5, Sec 21, DP 758644	Local	I191
Manilla	Manilla Post Office	164 Manilla Street	Lot 1, DP 619891	Local	I192
Manilla	New England Credit Union Building	168 Manilla Street	Lot 1, DP 334874; Lot 2, DP 955341	Local	I193
Manilla	Manilla and District Soldiers Memorial Hall	193 Manilla Street	Lot 13, Sec 21, DP 758644	Local	I194
Manilla	Residence	194–196 Manilla Street	Lot B, DP 367103	Local	I195
Manilla	Butcher shop	195 Manilla Street	Lot 2, DP 662653	Local	I196
Manilla	Royce Cottage, Yarramanbully School Building (Upper Manilla School) and Chinese Pioneers Memorial Garden	197 Manilla Street	Lot 1, DP 652667; Lot 1, DP 659730; Lot 1, DP 659730	Local	I197
Manilla	Shop	200 Manilla Street	Lot A, DP 367103	Local	I198
Manilla	Manilla Pharmacy Building	204–208 Manilla Street	Lot 62, DP 559389	Local	I199
Manilla	Residence	227 Manilla Street	Lot 5, DP 167643	Local	I200
Manilla	Imperial Hotel	230–238 Manilla Street	Lot 81, DP 603639; Lot 9, Sec 26, DP 758644	Local	I201
Manilla	Manilla Motors	240 Manilla Street	Lot 1, Sec 3, DP 8900; Lot 1, DP 715588	Local	I202
Manilla	Residence	272 Manilla Street	Lot 7, Sec 10, DP 758644	Local	I203
Manilla	Residence	44 Market Street	Lot 3, DP 105048	Local	I205
Manilla	Manilla General Cemetery	Namoi River Road	DP 752201	Local	I206
Manilla	Railway Viaduct across the flood plain	East to West from Namoi Street to Main Road 357		Local	I207
Manilla	Residence	64 Namoi Street	Lot 7A, DP 369222	Local	I208

Manilla	Residence	67 Namoi Street	Lot 15, Sec 26, DP 758644	Local	I209
Manilla	Residence	73 Namoi Street	Lot 131, DP 715040	Local	I210
Manilla	Residence	104 Namoi Street	Lot 6, DP 1133213	Local	I211
Manilla	Residence “Avonlea”	13 Railway Parade	Lot 6, DP 758644	Local	I212
Manilla	Residence “Conurra”	Ratcliffe Avenue	Lots 228–230, DP 752178	Local	I213
Manilla	Junction of Manilla and Namoi Rivers	River Street	Lot 56, DP 752201	Local	I214
Manilla	Manilla Historical Cemetery	River Street	Lot 2, Sec 42, DP 758644	Local	I215
Manilla	Manilla Showground	River Street	Lot 277, DP 752191	Local	I216
Manilla	Residence	83 River Street	Lot 1, DP 196021	Local	I217
Manilla	Residence	98 River Street	Lot 212, DP 752191	Local	I218
Manilla	St Andrew’s Presbyterian Church	Rowan Street	Lots A and B, DP 3681	Local	I219
Manilla	The Abbey	43–45 Rowan Street	Lot 11, DP 1002217	Local	I220
Manilla	Residence “Ngundi”	64 Rowan Street	Lot C, DP 310836	Local	I221
Manilla	Residence	80 Rowan Street	Lot 1, DP 300965	Local	I222
Manilla	Residence	94 Rowan Street	Lots 81 and 82, DP 527575	Local	I224
Manilla	Residence	106 Rowan Street	Lot 2, DP 326746	Local	I225
Manilla	Residence “Mayvale”	Rushes Creek Road	Lot A, DP 393149	Local	I228
Manilla	Manilla Railway Station	South Street	Land Number 301545	Local	I229
Manilla	Scout Hall	Strafford Street	Lots 18 and 19, Sec 26, DP 758644	Local	I230
Manilla	Uniting Church and Uniting Church Hall	Strafford Street	Lot 11, DP 789958	Local	I231
Manilla	Residence	42 Strafford Street	Lot 1, DP 570131	Local	I233
Manilla	Residence	46–48 Strafford Street	Lot 1, DP 924060	Local	I234
Manilla	Residence	50 Strafford Street	Lot 1, DP 919838	Local	I235
Manilla	Residence	56 Strafford Street	Lot 6, DP 664043	Local	I237
Manilla	Residence	57 Strafford Street	Lot 4, DP 570463	Local	I238
Manilla	Residence	67 Strafford Street	Lots 1–3, Sec 2, DP 5787	Local	I239
Manilla	Residence	68 Strafford Street	Lots 3 and 4, Sec 5, DP 5787	Local	I240

Manilla	Residence	78 Strafford Street	Lot 9, Sec 6, DP 5787	Local	I241
Manilla	Residence	79 Strafford Street	Lot 3, Sec 3, DP 5787	Local	I242
Manilla	Manilla Road Bridge/ Namoi River Bridge	Main Road 63 Manilla Street—Over the Namoi River between Market Street and Charles Street		Local	I243
Moonbi	Moonbi War Memorial Hall and Recreation Reserve	49–73 Gill Street	Lot 8, DP 1107105	Local	I245
Moonbi	Kootingal/Moonbi Cemetery and Chinaman's Grave Trees	Corner Mathew Street and Thomas Street	Lot 1–7, DP 1041237	Local	I246
Moonbi	Cellar storeroom of Coach and Horses Inn	New England Highway	Lots 1 and 2, Sec 2, DP 758701	Local	I247
Moonbi	Moonbi Lookout	New England Highway North	Lot 11, DP 263358	Local	I248
Moonbi	Concrete Bridge, New England Highway North (Monier Arch Bridge)	New England Highway North—Adjacent to Highway deviation between two Moonbi Hills (Kootingal)		Local	I249
Moore Creek	"Australia Arms"	Corner of Arthur and Holroyd Street	Lots 1, 2 and 13–16, Sec 20, DP 758702; Lots 1–5, 9 and 10, Sec 23, DP 758702	Local	I250
Moore Creek	Old tobacco shed at "Hillstone"	Davidsons Lane	Lots 7–9, 12, 30, 48, 62, 63 and 85, Part Lots 10, 11 and 12, DP 753830; Lots 1 and 2, DP 926649; Lot 331, DP 997737; Lot 11, DP 111888	Local	I251
Moore Creek	Moore Creek War Memorial Hall	Moore Creek Road	Lot 265, DP 753830	Local	I252
Moore Creek	Slab side hut	Tregarthen Road	Lot 8, DP 1050219	Local	I253
Moore Creek	Moore Creek Dam	Upper Moore Creek Road	Lot 7002, DP 94291; Lot 7015, DP 94293; Lot 9001, DP 94290; Lot 7008, DP 94292	Local	I254
Nemingha	Nemingha Hall	Kootingal Road	Lot 1, DP 329581	Local	I255
Nemingha	Nemingha School	Nundle Road	Lot 4, DP 48402; Lot 1, DP 232840	Local	I256

Nemingha	Nemingha Anglican Church	Nundle Road	Part Portion 31, DP 755334	Local	I257
Niangala	Former store and old butcher shop	Healy Street	Lot 15, Sec 1, DP 758774	Local	I258
Niangala	Niangala War Memorial Hall	Niangala Road	Lots 7 and 8, Sec 1, DP 758774	Local	I261
Niangala	Niangala Cemetery	Niangala—Weabonga Road	Lot 7002, DP 96287	Local	I262
Niangala	Niangala Weir	Niangala—Weabonga Road		Local	I263
Niangala	Port Stephens Cutting	Nowendoc Road		Local	I264
Niangala	Five Head Stamping Battery	27 Toby Road	Lots 61 and 62, DP 42102; Part Lots 30, 44, 49–51 and 58, DP 755346; Lots 1–6, Sec 5, DP 758774	Local	I265
Nundle	Church	63 Gill St	Lot 1, DP 770383	Local	I268
Nundle	St Peter's Catholic Church	15 Innes St	Lot 1, DP 786993	Local	I269
Nundle	Former Courthouse/ Museum and Police Station and Residence	38–40 and 41–43 Jenkins Street	Lot 701, DP 96508	Local	I270
Nundle	Nundle Shire Office	58 Jenkins Street	Lot 1 and Part Lot 2, Sec 21, DP 758798	Local	I271
Nundle	All Saints Church of England	70 Jenkins Street	Part Lot 4, Sec 3, DP 758798	Local	I272
Nundle	Residence	79 Jenkins Street	Lot 2, DP 591822; Lots 12 and 13, Sec 2, DP 758798	Local	I273
Nundle	Odgers and McClelland Exchange Stores	81 Jenkins Street	Lot 172, DP 1072542	Local	I274
Nundle	Jenkins St Antiques, Odgers and McClelland General Store	83 Jenkins Street	Lot 101, DP 598667	Local	I275
Nundle	Jenkins St Guest House (Former Bank of New South Wales)	85 Jenkins Street	Lot 171, DP 1072542	Local	I276
Nundle	Peel Inn	89 Jenkins Street	Lot A, DP 369396; Lots 1–3, DP 997480	Local	I277
Nundle	Old Church Boutique Primitive Methodist Church	90–92 Jenkins Street	Lots 6 and 13, Sec 31, DP 758798	Local	I278
Nundle	Nundle Post Office	91 Jenkins Street	Lot 1, DP 714004	Local	I279

Nundle	Nundle Public School	93–97 Jenkins Street	Lot 1, DP 123390; Lot 9, Sec 30A, DP 758798	Local	I280
Nundle	Nundle Memorial Hall and Library	101 Jenkins Street	Lots 8 and 10, Sec 30A, DP 758798	Local	I281
Nundle	Nundle Cemetery	Nundle Creek Road	Lot 7001, DP 1030464	Local	I282
Ogunbil	Ogunbil Brick Shearing Shed and Silo	Ogunbil Road	Lots 158 and 234, DP 755350; Lot 1, DP 807846	Local	I283
Piallamore	Old Piallamore School Building	Nundle Road	Lot 183, DP 733065	Local	I285
Piallamore	St Martin's Anglican Church	Nundle Road	Lot 1, DP 928322	Local	I286
Retreat	Retreat Main House and Granite Store at Retreat Station	Kingstown Road	Portions 4, 15, 16 and 24, Part Lot 25, DP 753845	Local	I287
Retreat	"West Retreat"	Longford—Retreat Road	Lot 3, DP 46437; Lot 11, DP 602467; Lot 4, DP 700812; Lots 15 and 16, DP 753844	Local	I288
Retreat	West Retreat Bridge	Retreat Road		Local	I289
Somerton	Somerton Cemetery	Being Point	PO 74/1, DP 758910	Local	I290
Somerton	Slab Hut	Bloomfield Street	Lot 167, DP 755340; Lot 1, DP 128155	Local	I291
Somerton	Somerton Police Station	93–97 Bloomfield Street	Lot 17, Sec 4, DP 758910	Local	I292
Somerton	"Stratharlie"	Oxley Highway West	Lot 42, DP 1056638	Local	I293
Somerton	Somerton Racecourse	Racecourse Road	Lot 209, DP 257191	Local	I294
Somerton	Former Somerton Post Office and Store	Scotland Street	Lot 4, DP 737067	Local	I295
Somerton	St Mark's Anglican Church	Scotland Street	Lot 4, Sec 5, DP 758910	Local	I296
Somerton	St Mathew's Presbyterian Church	Scotland Street	Lot 8, Sec 4, DP 758910	Local	I297
Somerton	Somerton Hall	Scotland Street	Lot 9, Sec 19, DP 758910	Local	I298
Somerton	Somerton School	Corner Scotland and Milkmaid Streets	Lot 2, Sec 6, DP 758910	Local	I299
Tamworth	East Tamworth Station Pedestrian Bridge	Over Bourke Street		Local	I300
Tamworth	Office building	12A Bourke Street	Lot 10, DP 1044770	Local	I301

Tamworth	Tamworth House	34 Bourke Street	Lot 19, DP 456158	Local	I302
Tamworth	House	38 Bourke Street	Lot 10, DP 651752	Local	I303
Tamworth	House	100 Bourke Street	Lot 101, DP 548846	Local	I304
Tamworth	St Paul's Church, house beside Retreat Theatre and Retreat Theatre	63 Bridge Street	Lots 2–4 and 7–9, DP 91043; Lots 11 and 12, DP 131248	Local	I305
Tamworth	House	65 Bridge Street	Lot 1, Sec D, DP 194218	Local	I306
Tamworth	Entrance to Endeavour Drive off Brisbane Street—street lights	Brisbane Street	Lot 1, DP 1108482	Local	I308
Tamworth	Anzac Park gates, gazebo and street lamps	Brisbane Street	Lot 1, DP 668906	Local	I309
Tamworth	"Regent" Cinema	3–5 Brisbane Street	Lot 1, DP 583861	Local	I310
Tamworth	Shopfront glass	78–80 Brisbane Street	Lot 1, DP 318176; Lot 1, DP 323786	Local	I311
Tamworth	Mechanics Institute	87–93 Brisbane Street	Lot 81, DP 818564; Lot 1, DP 356314	Local	I312
Tamworth	Tamworth Railway Station (also known as Tamworth Railway Station, yard group, and yard group moveable relics)	100 Brisbane Street	Lot 37, DP 1006137; RLY 279074; Part Lot 38, DP 1006137	State	I313
Tamworth	House	102 Brisbane Street	Lot 1, Sec 34, DP 758951	Local	I314
Tamworth	House "Glen Moor"	106 Brisbane Street	Lot 10, DP 668914	Local	I315
Tamworth	House	123 Brisbane Street	Lot 1, DP 104631	Local	I316
Tamworth	House	129 Brisbane Street	Lot 4, DP 17530	Local	I317
Tamworth	Main School Building "Calrossy"	136–142 Brisbane Street	Lot 100, DP 800972	Local	I318
Tamworth	House	141A–141B Brisbane Street	Lot 2, Sec 62, DP 344900	Local	I319
Tamworth	House	149 Brisbane Street	Lot A, DP 17553	Local	I320
Tamworth	Grandstand (at race track)	Britten Road	Lot 92, DP 259787	Local	I307
Tamworth	Original AA Building Site	Calala Lane	Lot 5, DP 1103706	Local	I321
Tamworth	House	43 Carthage Street	Lot 1, DP 197435	Local	I322
Tamworth	House	45 Carthage Street	Lot 1, DP 197221	Local	I323

Tamworth	House	47 Carthage Street	Lot 2, DP 137243	Local	I324
Tamworth	House	64 Carthage Street	Lot 1, Sec 48, DP 304624	Local	I325
Tamworth	House	75 Carthage Street	Lot 1, Sec 34, DP 318909	Local	I326
Tamworth	House	77 Carthage Street	Lot 1, Sec 34, DP 182227	Local	I327
Tamworth	House	79 Carthage Street	Lot 1, DP 199709; Lot 9, DP 652919	Local	I328
Tamworth	House	81 Carthage Street	Lot 1, DP 914393	Local	I329
Tamworth	Baptist Church	86 Carthage Street	Part Lot 2, Sec 46, DP 318909	Local	I330
Tamworth	House	89 Carthage Street	Lot 1, Sec 34, DP 983675	Local	I331
Tamworth	House “Salona”	90 Carthage Street	Lot 1, DP 552394	Local	I332
Tamworth	House	92 Carthage Street	Lot B, Sec 46, DP 365446	Local	I333
Tamworth	House	94–96 Carthage Street	Lot 1, Sec 46, DP 170599; Lot 1, Sec 46, DP 170696	Local	I334
Tamworth	House	95 Carthage Street	Lot 95, DP 1077096	Local	I335
Tamworth	House	100 Carthage Street	Lot 8A, DP 409537	Local	I336
Tamworth	St John’s Church	102 Carthage Street	Lot 4, DP 136014; Lots 5 and 6, DP 136015; Lot 3, DP 664318	Local	I337
Tamworth	House	134 Carthage Street	Lot 72, DP 525590	Local	I338
Tamworth	House	138 Carthage Street	Lot 2, DP 5740	Local	I339
Tamworth	House	140 Carthage Street	Lot 1, Sec 43, DP 5740	Local	I340
Tamworth	House	142 Carthage Street	Lot A, DP 320339	Local	I341
Tamworth	House	150 Carthage Street	Lot A, DP 334501	Local	I342
Tamworth	House	153 Carthage Street	Lot 1, Sec 39, DP 531644	Local	I343
Tamworth	House	170 Carthage Street	Lot 1, DP 500490	Local	I344
Tamworth	House	178 Carthage Street	Lot 43, DP 632655	Local	I345
Tamworth	House	65 Church Street	Lot 401, Sec K, DP 620487	Local	I346
Tamworth	House	75 Church Street	Lot A, Sec K, DP 152966	Local	I347

Tamworth	House	77 Church Street	Lot B, Sec K, DP 152966	Local	I348
Tamworth	House	79 Church Street	Lot C, Sec K, DP 152966	Local	I349
Tamworth	House	95 Crown Street	Lot 3, Sec G, DP 329729	Local	I350
Tamworth	House	97 Crown Street	Lot 4, Sec G, DP 329729	Local	I351
Tamworth	House	8 Darling Street	Lot 100, Sec 18, DP 805150	Local	I352
Tamworth	House	10 Darling Street	Lot 1, DP 782584	Local	I353
Tamworth	House	16 Darling Street	Lot 2, Sec 18, DP 933812	Local	I354
Tamworth	Railway House	20 Darling Street	Sec 32, Departmental Residence	Local	I355
Tamworth	Dwelling	30–32 Darling Street	Lot 120, DP 1069031	Local	I540
Tamworth	House	61 Darling Street	Lot 1, Sec 53, DP 325982	Local	I356
Tamworth	House	63 Darling Street	Lot 2, DP 325982	Local	I357
Tamworth	House	65 Darling Street	Lot 3, Sec 53, DP 325982	Local	I358
Tamworth	House	67 Darling Street	Lot 2, DP 336908	Local	I359
Tamworth	House	69 Darling Street	Lot 1, DP 336908	Local	I360
Tamworth	Main group of hospital buildings	31 Dean Street	Lot 2, DP 533835; Lot 99, Part Lot 109, DP 753848	Local	I361
Tamworth	House	67 Denison Street	Lot 1, DP 199229	Local	I362
Tamworth	House	89 Denison Street	Lot 4, Sec F, DP 11334	Local	I363
Tamworth	House	91 Denison Street	Lot 3, Sec F, DP 11334	Local	I364
Tamworth	House	99 Denison Street	Lot 2D, DP 162035	Local	I365
Tamworth	House “Carrick”	120 Denison Street	Lot 1, DP 784438	Local	I366
Tamworth	House “Calala Cottage”, slab hut and beehive building	138–144 Denison Street	Lots 10–12, DP 38477	Local	I367
Tamworth	House	93 Denne Street	Lot 2, Sec V, DP 510902	Local	I368
Tamworth	House	95 Denne Street	Lot 1, Sec V, DP 510902	Local	I369
Tamworth	House	115 Denne Street	Lot 6A, DP 157655	Local	I370

Tamworth	Main Northern Railway over the Peel River—Viaduct West of the Peel River, Railway Bridge, Viaduct East of the Peel River and the Railway Overbridge over Peel Street	From Ebsworth Street—Macquarie Street		State	I371
Tamworth	Lands Office	25 Fitzroy Street	Lot 22, Sec 14, DP 758951	Local	I373
Tamworth	Town Hall	26–28 Fitzroy Street	Lot 26, DP 1099518	Local	I374
Tamworth	House	59 Fitzroy Street	Lot 12, Sec 44, DP 304762	Local	I375
Tamworth	House	76 Fitzroy Street	Lot 22, Sec 45, DP 758951	Local	I376
Tamworth	House	96 Fitzroy Street	Lot 2, DP 513224	Local	I377
Tamworth	House	98 Fitzroy Street	Lots 49 and 50, DP 507; Lots 1–4, DP 456473	Local	I378
Tamworth	House	122 Fitzroy Street	Lot A, DP 27254	Local	I379
Tamworth	War Memorial	Gipps Street	Road Seg No 100506	Local	I380
Tamworth	House	11 Gipps Street	Lot B, Sec I, DP 155275	Local	I381
Tamworth	House	14 Gipps Street	Lot 3, Sec V, DP 510902	Local	I382
Tamworth	House	15 Gipps Street	Lot C, Sec H, DP 162520	Local	I383
Tamworth	House	17 Gipps Street	Lot B, Sec H, DP 162520	Local	I384
Tamworth	House	19 Gipps Street	Lot A, Sec H, DP 162520	Local	I385
Tamworth	House	21 Gipps Street	Lot 1, DP 151413	Local	I386
Tamworth	House	22 Gipps Street	Lot 1, Sec U, DP 743407	Local	I387
Tamworth	House	26 Gipps Street	Lot A, DP 153716	Local	I388
Tamworth	House	98 Goonan Street	Lot 11, DP 1113663	Local	I372
Tamworth	Cottage	37 Griffin Avenue	Lot A, Sec 33, DP 156986	Local	I389
Tamworth	Cottage	39 Griffin Avenue	Lot B, DP 156986	Local	I390
Tamworth	Cottage	46 Griffin Avenue	Lot A, Sec 33, DP 377663	Local	I393

Tamworth	Cottage	47 Griffin Avenue	Lot B, Sec 33, DP 402188	Local	I394
Tamworth	Cottage	48 Griffin Avenue	Lot B, DP 377663	Local	I395
Tamworth	Cottage	51 Griffin Avenue	Lot 5, DP 301132	Local	I396
Tamworth	Cottage	56 Griffin Avenue	Lot B, DP 329817	Local	I397
Tamworth	House	68 Griffin Avenue	Lot 100, DP 802488	Local	I398
Tamworth	House	94 Griffin Avenue	Lot 141, Sec 35, DP 602361	Local	I399
Tamworth	House	96 Griffin Avenue	Lot 142, Sec 35, DP 602361	Local	I400
Tamworth	House “The Pines”	28 Hill Street	Lots 4 and 7, DP 37897	Local	I401
Tamworth	House	33 Hill Street	Lots 3–5, DP 1104909	Local	I402
Tamworth	House	43 Hill Street	Lot 1, DP 330939	Local	I403
Tamworth	House	65 Hill Street	Lots 18–20, DP 1097911	Local	I404
Tamworth	West Tamworth Railway Station	In and Out Streets	Lot 42, DP 1006078	Local	I405
Tamworth	Tamworth Correctional Centre	152–160 Johnston Street	Lots 4–6, DP 809662	Local	I406
Tamworth	House	King George V Avenue	Lot A, DP 161615	Local	I407
Tamworth	House	King George V Avenue	Lot 8, DP 755334	Local	I408
Tamworth	Wells and Pumping Station off Peel River	King George V Avenue and Scott Road, south bank of Peel River	Lot 1, DP 152642; Lot 1, DP 755334; Lot 229, DP 755334, Old Scott Road—Road Reserve	State	I412
Tamworth	House	2–24 King George V Avenue	Lots 21 and 22, DP 557775	Local	I409
Tamworth	Tobacco Kiln	73–95 King George V Avenue	Lot 9, DP 755334	Local	I410
Tamworth	Tobacco Kiln	119–139 King George V Avenue	Lot 13, DP 62854	Local	I411
Tamworth	House	16 Macquarie Street	Lot A, Sec 51, DP 415711	Local	I413
Tamworth	House	18 Macquarie Street	Lot 2, DP 3151	Local	I414
Tamworth	House	86 Marius Street	Lot 1, DP 1100592	Local	I415
Tamworth	Hospital “Allambie”	100 Marius Street	Lot 1, DP 663144; Lot 1, DP 745341	Local	I416

Tamworth	House “Marius Cottage”	112 Marius Street	Lot 51, Sec 31, DP 518883	Local	I417
Tamworth	House	123 Marius Street	Lot 1, Sec 17, DP 743803	Local	I418
Tamworth	House “St Austel”	130 Marius Street	Lot 1, DP 719438	Local	I419
Tamworth	House “The Cottage”	141 Marius Street	Lot 1, DP 620964	Local	I420
Tamworth	Old hotel building	143–145 Marius Street	Lot 3, DP 629335	Local	I421
Tamworth	Wesleyan Church and house	144 Marius Street	Lot 1, Sec 33, DP 724125	Local	I422
Tamworth	Tamworth Hotel	147 Marius Street	Lot 1, Sec 16, DP 79182	Local	I423
Tamworth	Church	150, 152–154 and 156 Marius Street	Lots 10–12, DP 874106	Local	I424
Tamworth	Northern Daily Leader	179 Marius Street	Lot 1, DP 56457; Lot B, DP 333474	Local	I425
Tamworth	Imperial Hotel	181–195 Marius Street	Lot 89, Sec 15, DP 812988	Local	I426
Tamworth	House	204–208 Marius Street	Lot 10, DP 789014	Local	I427
Tamworth	Old convent building (also known as Dominican Roman Catholic Convent)	223–227 Marius Street	Lot 102, DP 629477	State	I428
Tamworth	Power House Motel and monument	248 Marius Street	Lot 40, DP 736594	Local	I429
Tamworth	House	29 Napier Street	Lot 18A, Sec 56, DP 435295	Local	I430
Tamworth	House	31 Napier Street	Lot 171, DP 210747	Local	I431
Tamworth	House	46–48 Napier Street	Lots 2–3, DP 7697; Lot A, DP 950251	Local	I432
Tamworth	House “Girrawilla”	62 Napier Street	Lot A, Sec 62, DP 376291	Local	I433
Tamworth	House “Avondale”	66 Napier Street	Lot 41, DP 582260	Local	I434
Tamworth	House	66A Napier Street	Lots 5 and 6, DP 249132; Lot 4, DP 581260	Local	I435
Tamworth	House	114 North Street	Lot 267, DP 716674	Local	I436
Tamworth	House	116 North Street	Lot 1, DP 19805	Local	I437
Tamworth	House	130 North Street	Lot B, DP 362159	Local	I438
Tamworth	House	132 North Street	Lot Y, DP 381871	Local	I439

Tamworth	House “Glenbrook”	28 Nundle Road	Lot 1, DP 117363	Local	I440
Tamworth	House	29 Parry Street	Lot 36, DP 21859	Local	I441
Tamworth	House	48–50 Peel Street	Lot 16, DP 527133	Local	I442
Tamworth	Former brewery building	130–138 Peel Street	Lot 130, DP 1044562	Local	I443
Tamworth	Hotel Tattersalls	146–148 Peel Street	Lot 6, Sec 28, DP 620371	Local	I444
Tamworth	Group of shops	164 Peel Street	Lot 4, Sec 28, DP 733156	Local	I445
Tamworth	Former Square Man Hotel and old flour mill	165–179 Peel Street	Lot 165, DP 1124940	Local	I446
Tamworth	Old courthouse building	212 Peel Street	Lot 21, Sec 18, DP 758951	Local	I447
Tamworth	Community Centre (also known as Tamworth Peel Barracks)	214 Peel Street	Lot 21, DP 778033	State	I448
Tamworth	Commercial building	226 Peel Street	Lot 1, DP 783751	Local	I449
Tamworth	Courthouse Hotel	232 Peel Street	Lot 1, Sec 17, DP 744585	Local	I450
Tamworth	Group of shops	235 and 237 Peel Street	Lot 235, DP 1015836; Lot 237, DP 1015836	Local	I451
Tamworth	Group of shops	239 Peel Street	Lot 1, Sec 2, DP 194694	Local	I452
Tamworth	Shop	265–267 Peel Street	Lot 1, DP 201532	Local	I453
Tamworth	Shop	277 Peel Street	Lots 1–3, DP 196730	Local	I454
Tamworth	Central Hotel	330–334 Peel Street	Lots 1–8, DP 19100	Local	I455
Tamworth	Hotel and shops	395–401 Peel Street	Lot 1, DP 555615	Local	I456
Tamworth	National Australia Bank Building	400–402 Peel Street	Lot B, Sec 15, DP 154125	Local	I457
Tamworth	Post Office	402A Peel Street	Lot 1, DP 773787	State	I458
Tamworth	Commonwealth Bank Building	404 Peel Street	Lot 1, DP 154810; Lot 1, DP 197246; Lot 2, DP 510893	Local	I459
Tamworth	Former ANZ Bank Building	429 Peel Street	Lot 13, DP 253033	Local	I460
Tamworth	Masonic Temple	462–464 Peel Street	Lot 1, Sec 13, DP 976614	Local	I461
Tamworth	Shops	465–469 Peel Street	Lot 2, DP 81235	Local	I462

Tamworth	Monument	Corner Piper and Peel Streets	Lot 11, DP 739273	Local	I463
Tamworth	House	28 Piper Street	Lot 11, DP 509962	Local	I464
Tamworth	House	42 Raglan Street	Lots 45, A1 and A4, DP 736980	Local	I465
Tamworth	House	64 Raglan Street	Lot 1, DP 203220	Local	I466
Tamworth	House	10 Rawson Avenue	Lot 15, DP 1575	Local	I467
Tamworth	House	14 Rawson Avenue	Lot 13, DP 1575	Local	I468
Tamworth	House	19 Rawson Avenue	Lot 6, DP 9342	Local	I469
Tamworth	House	21 Rawson Avenue	Lot 5, DP 9342	Local	I470
Tamworth	House	23 Rawson Avenue	Lot 4, DP 9342	Local	I471
Tamworth	House	62 Rawson Avenue	Lot 1, DP 772206; Lot 1, DP 930911	Local	I472
Tamworth	House	35 Roderick Street	Lot B, DP 412256; Lot 1, DP 942053	Local	I473
Tamworth	House	65 Roderick Street	Lot 18, Sec 59, DP 758951	Local	I474
Tamworth	House	79 Roderick Street	Lot 18, Sec 66, DP 758951	Local	I475
Tamworth	Tobacco kiln	Scott Road	Lot 35, DP 826572	Local	I476
Tamworth	Monuments at the Tamworth Cemetery	Showground Road	Lot 1, DP 724326; Lot 3, DP 152850; Lot 7004, DP 1030068	Local	I477
Tamworth	Tamworth Primary School and residence	Corner Upper and Brisbane Streets	Lots 1–11, Sec 54, DP 758951; Lots 418 and 419, DP 821635	Local	I487
Tamworth	House	24 Upper Street	Lot 11, DP 2908	Local	I478
Tamworth	House “Shield Hill”	32 Upper Street	Lot 1, DP 16452	Local	I479
Tamworth	House	38 Upper Street	Lot 51, DP 525256	Local	I480
Tamworth	House	40 Upper Street	Lot 52, DP 525256	Local	I481
Tamworth	House	44 Upper Street	Lot 54, DP 543039	Local	I482
Tamworth	House	51 and 53 Upper Street	Lots 21 and 22, DP 881281	Local	I483
Tamworth	House	55 Upper Street	Lot 1, Sec 46, DP 281	Local	I484
Tamworth	House	57 Upper Street	Lot 6, Sec 46, DP 281	Local	I485
Tamworth	House	59 Upper Street	Lot 7, Sec 46, DP 281	Local	I486

Tamworth	House	83 Upper Street	Lot 1, Sec 45, DP 14279	Local	I488
Tamworth	House	89 Upper Street	Lot 3, DP 315498	Local	I489
Tamworth	House	117 Upper Street	Lot 131, Sec 43, DP 504991	Local	I490
Tamworth	House	119 Upper Street	Lot 12, DP 666152	Local	I491
Tamworth	House	121 Upper Street	Lot A, Sec 43, DP 398327	Local	I492
Tamworth	St Nicholas Church	18 White Street	Lot 103, Sec 14, DP 629477	Local	I493
Tamworth	House	34 White Street	Lot 1, DP 6927970; Lot 13, DP 4457	Local	I494
Tamworth	House	46A White Street	Lot 2, Sec 56, DP 414091	Local	I495
Tamworth	House	46 White Street	Lot 3, Sec 56, DP 414091	Local	I496
Tamworth	House	47 White Street	Lot 1, Sec 43, DP 202888	Local	I497
Tamworth	House	48 White Street	Lot A, Sec 56, DP 954555	Local	I498
Tamworth	House	50 White Street	Lot B, Sec 56, DP 309312	Local	I499
Tamworth	House	52 White Street	Lot C, Sec 56, DP 954555	Local	I500
Tamworth	House “Glen Evilly”	53–55 White Street	Lot 55, DP 1081363	Local	I501
Tamworth	House	56 White Street	Lot 12, DP 666082	Local	I502
Tamworth	House “Minna-murra”	69 White Street	Lot 11, DP 519459	Local	I503
Tamworth	House	71 White Street	Lot 1, Sec 64, DP 977444	Local	I504
Tamworth	House “Broms-grove”	72 White Street	Lot 12, DP 666080	Local	I505
Tamworth	House	77 White Street	Lot A, Sec 64, DP 346149	Local	I506
Tamworth	House	79 White Street	Lot 1, Sec 64, DP 120697	Local	I507
Timbumburi	Timbumburi School	New England Highway South	Lot 1, DP 810934	Local	I508
Tintinhull	Railway bridge at road deviation	Road Reserve New England Highway North		Local	I509
Tintinhull	“Tintinhull Farm”	Tintinhull Road	Lot 47, DP 1072871	Local	I510

Tintinhull	Tintinhull School	Tintinhull Road	Lots 97 and 191, DP 753848	Local	I511
Upper Manilla	Dingley Dell Uniques	Main Road	Lot 14, DP 1110090	Local	I179
Upper Manilla	Oakey Creek Rail Bridge	State Road 63 Barraba Branch Railway, 14km North-Northwest of Upper Manilla		State	I072
Watsons Creek	Former Watsons Creek School	25 Old School Road	Lot 102, DP 753839	Local	I512
Watsons Creek	Lost Boy's Grave "Bantry"	8 Den Mountain Road	Lot 121, DP 753839	Local	I513
Watsons Creek	Miners cottage	Lower Watsons Creek Road	Lot 67, DP 753839	Local	I514
Watsons Creek	Watsons Creek Hall	Watsons Creek Road	Lot 42, DP 753839	Local	I516
Watsons Creek	Former store "Gunadoo"	2 Watsons Creek Road	Lot 73, DP 753839	Local	I515
Watsons Creek	Former Post Office "Craiggwan"	2444 Watsons Creek Road	Lot 63, DP 753839	Local	I517
Weabonga	Catholic Church	Britten Street	Lots 4, 5 and 18, Sec 2, DP 759062	Local	I518
Weabonga	Former Anglican Church	Mitchell Street	Lot 9, Sec 1, DP 759062	Local	I520
Weabonga	Weabonga Hall	Mitchell Street	Lot 10, Sec 2, DP 759062	Local	I521
Weabonga	Old courthouse kitchen and police station	Frappell Street	Lots 2 and 3, Sec 3, DP 759062	Local	I522
Weabonga	Weabonga School	Mitchell Street	Lot 6, Sec 8, DP 759062	Local	I523
Weabonga	Weabonga Cemetery	Weabonga Road	Reserve Number 14193; Lot 7003, DP 96286	Local	I524
Winton	"Dalblair" homestead	Dalblair Lane	Lots 18–25, 28, 31, 34–41, 51–52 and 57–58, DP 755330; Lot 1, DP 243629; Lot 1, DP 664998	Local	I525
Winton	North/South Stock Route	Hardigan's Lane		Local	I526
Winton	Winton Cemetery	Old Winton Road	Lot 7001, DP 1026359	Local	I527
Woodsreef	Woodsreef Cemetery	Old Bundarra Road	Lot 46, DP 752205	Local	I528

Woodsreef	St John's Anglican Church	Woodsreef Road	Lot 73, DP 752205	Local	I529
Woolbrook	"Trainview" residence	Back Woolbrook Road	Lot 1, DP 538519	Local	I530
Woolbrook	Old cottage—rear of "Trainview" residence	Daisy Street	Lot 1, DP 538519	Local	I531
Woolbrook	Woolbrook Hall	Limbri-Woolbrook Road	Portion 151, DP 753846	Local	I532
Woolbrook	Woolbrook Rail Bridge over McDonald River	Main Northern Railway	Main Northern Railway	State	1539
Woolbrook	Former Commonwealth Bank "Curlew"	11 Singh Street	Lots 155 and 199, DP 753846	Local	I533
Woolbrook	"Riverview" residence	14 Singh Street	Lots 184 and 185, DP 753846	Local	I534
Woolomin	St Mary's Anglican Church	50–52 Frederick Street	Lot 3, Sec 8, DP 759117	Local	I536
Woolomin	Residence	Corner Munro Street and Gap Road	Lot 222, DP 755350	Local	I537
Woolomin	Residence	86–88 Nundle Road	Lot 1, DP 127996; Lots 1 and 14, Sec 14, DP 759117	Local	I538

APPENDIX D

PLATES



Plate 1 Adjacent north of Quarry looking north, showing disturbed and modified landform.



Plate 2 Vehicle track looking east showing excavated spoil left of track and gullying erosion on track



Plate 3 Gullying erosion on track, looking east at eastern extent of project area



Plate 4 Dam adjacent east of Quarry looking south



Plate 5 Exposure on contour bank south of dam, looking north



Plate 6 Outcropping andesite, erosion and earthworks, southern extent of project area looking southwest



Plate 7 Andesite boulders with recent machine damage



Plate 8 Loamy clay soil sheetwash erosion exposure, base of slope in east of project area looking north



Plate 9 Contour banks, areas of exposure and example of vegetation coverage on slope in west of the project area, looking north



Plate 10 Scarred tree, TQS-ST1 looking east



Plate 11 Location of scarred Tree, TQS-ST1 looking east

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IACA
ACCREDITED MEMBER™

REPORT:

ARBORICULTURAL ASSESSMENT

OF

Scarred Tree/s

AT

Tamworth Quarry Solar Project
Country Road
Westdale NSW

FOR

Prepared for KDC

By Danny Draper
13 July 2020
Reference 22015

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Appendices

Appendix A **Sustainable Retention Index Value (SRIV) Version 4 (IACA 2010)**

Appendix B **Glossary of terminology (IACA 2009)**

1.0 SUMMARY

Urban Tree Management Australia© (UTMA) prepared this report for Courtney Sargent – Town Planner, KDC Suite 2, 125 Bull Street, Newcastle NSW 2302 on behalf of Providence Asset Group.

The report examines 1 tree shown within Tamworth Quarry, Country Road, Westdale NSW (*the site*) as shown in the Aerial Photograph and summarized in Table 1.0. Detailed arboricultural assessment of the tree revealed: Tree 1 / TQS-ST1, had 1 older trunk wound to west, likely to be derived of Aboriginal cultural origin, and 3 other recent wounds on the lower trunk to north and west, likely to be derived from abrasion impact events from grazing stock.



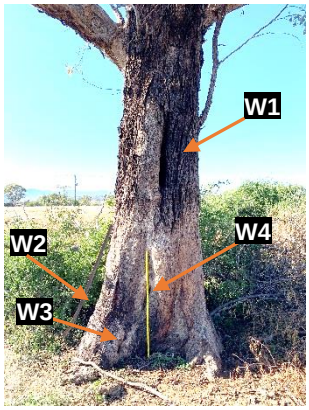
Aerial Photograph of Tamworth Quarry, Country Road, Westdale NSW, with red circle showing location of Tree 1 / TQS-ST1. Source: Google Maps, Country Road, Westdale NSW, viewed 13/07/2020, https://www.google.com/maps/search/Country+road,+Westdale+/@-31.114388,150.8648596,1983m/data=!3m1!1e3 .

Table 1.0 Summary of each tree including likely age, wounding and cause of wounding.

Tree No. / Archaeological No.	**Genus and species**	**Common name**	**1. Age range of tree** in yrs. approx. / **2. Age range of wound/s** in yrs. approx.	**Likely origin of wound/s**
1 / TQS-ST1	*Eucalyptus conica* H. Deane & Maiden	Fuzzy Box	**1.0** >250 - <300 **2.0** >150 - <250 (Wound 1) >10 - <50 (Wounds 2 – 4)	1. Aboriginal cultural origin. (Wound 1) 2. Abrasion impact event from livestock. (Wounds 2 – 4)

Photograph/s of tree/s showing wound/s






Wound 1 (W1)


Wound 2 (W2)

2.0 INTRODUCTION

Danny Draper *(the author)* attended *the site* containing Tree 1 / TQS-ST1 on Monday 6 July 2020 and its growing environment and wounding was examined and assessed from the ground. The inspection and assessment were conducted in the company of Donny Fermor, Sites Officer, Tamworth Local Aboriginal Land Council, and Steve Dietrich of Tamworth Regional Council. This inspection was undertaken to determine the likely cause and estimated age of scarring, the wounds' longevity, protection if shown to be of Aboriginal cultural origin, subject to proposed works nearby or removal and conservation, where appropriate.

The dimensions of the tree wound/s were recorded, and each tree and wound/s photographed by the author. The age of each tree provided is an estimate only and offered within a range due to the uncertainty of such unsubstantiated field observations without the application of Dendrochronology or other records. Without such precise data the age of trees is usually considered in stages of life span against their biomass *in situ* as Young (0-20%), Mature (20-80%) and Over-mature (senescent) (80-100%).

Tree Protection – subject to Development works - If this tree is to be retained *in situ* it will require protection on this development site by the application of AS4970(2009) *Protection of trees on development sites* and this will be discussed further.

Risk Assessment - As the tree will be in a *high use* area with the changed land use of the site, a Tree Risk Assessment (Table 4.0) was undertaken of *the tree* and its growing environment as part of a Visual Tree Assessment (Mattheck & Breloer 1994), conducted from the ground to determine hazards and risk to the targets identified within *the site* proximate *the tree*.

The tree risk assessment works recommended are prioritized 1-3:

Priority 1 - Immediate remedial action, unacceptable consequences/extreme safety risk, *Removal, Pruning*, *Isolation*
Priority 2 - Action within 6 months, *Removal, Pruning*, *Further investigative or scientific testing works required*
Priority 3 - Currently no action required within the next 12 months

This report assessed 1 tree in a *High-use* area which will be subject to vehicular and pedestrian movement with a solar array nearby. Works are recommended for trees in *High-use* for *Priority 1* or *Priority 2* only. Recommendations are presented in tabular form, **Table 2.0** *Tree Risk Assessment Priority 1 Tree/s to be removed or pruned* and **Table 3.0** *Tree Risk Assessment Priority 2 Trees and requiring further investigative works*. Trees identified as *Tree Risk Assessment Priority 3 Currently no action required within the next 12 months* do not require any works and are not included in the Recommendations. The Tree Risk Assessment is shown in Table 4.0.

To minimise harm to the tree, the crown will require pruning to remove deadwood, save for branches that are hollow and contain habitat nesting sites or are potential habitat nesting sites. Here such branches should be shortened to preserve the hollows while reducing the risk of branch collapse and are to be undertaken per AS4373(2007) *Pruning of amenity trees*.

Table 2.0 Tree Risk Assessment Priority 1 Trees to be removed or pruned as indicated.

Tree No	Priority for Removal – unacceptable consequences/extreme safety risk 1 = Yes	Priority for Pruning / works Deadwooding throughout crown. Reduction Pruning over target in **L**ower / **M**id / **U**pper crown, to **N**, **S**, **E**, **W**. Selective Pruning over target in **L**ower / **M**id / **U**pper crown, to **N**, **S**, **E**, **W**.
1 / TQS-ST1	N/A	1. Isolate tree within a 17 m radius fenced enclosure or design to allow the area to be separated and designated as low use. 2. Remove weeds manually to protect tree roots. Poison weeds using bush regeneration techniques. 3. Post weed removal - Mulch to 100 mm deep with leaf litter mulch.

Table 3.0 Tree Risk Assessment Priority 2 Tree/s requiring Removal, Pruning, Further investigative or scientific testing works.

Tree No.	*1 Aerial inspection* *2 Aerial inspection & Resistograph test*	*1 Resistograph test of Trunk from ground* *2 Aerial inspection & Resistograph test of Trunk*	*1 Root crown excavation* *2 Root crown excavation & Resistograph test*	*1 Ongoing monitoring required*	Removal Deadwooding throughout crown. Reduction Pruning over target in **L**ower / **M**id / **U**pper crown, to **N**, **S**, **E**, **W**. Selective Pruning over target in **L**ower / **M**id / **U**pper crown, to **N**, **S**, **E**, **W**.
1 / TQS-ST1	N/A	N/A	N/A	N/A	Deadwooding - Remove deadwood throughout crown while maintaining habitat hollows.

Table 4.0 Tree Risk Assessment – Tree/s in high-use areas

Tree No.	Genus & species / Common Name	Condition **G** = Good **F** = Fair **P** = Poor **M** = Moribund **D** = Dead	Age **Y** = Young **M** = Mature **O** = Overmature	Ht. Approx. Metres	Defects **CH** = Cavity / Hollow **CB** = Cracks/Bulge/Buckling **FR** = Fungal Fruiting bodies **SL** = Severe Lean (>45°) **PL** = Progressive Lean <45° **DB** = Detached branch **BI** = Bark Inclusion **BD** = Bird damage **B** = Borer **L** = Lopped **RD** = Root Damage/Heaving / Soil cracks **DW** = Large deadwood **OT** = Other (comment?)	Tree part	Conditions of concern	Part size, mm	Fall distance, metres	Target number	Target protection	Likelihood												Consequences				Risk rating of part (from Matrix 2) **L** = Low **M** = Moderate **H** = High **E** = Extreme	Priority **Priority 1** – Immediate remedial action **P1R** = **Removal** **P1P** = **Pruning** **Priority 2** – Action within 6 months Further investigative works, pruning removal **Priority 3** – Currently no action required within the next 12 months
												Failure				Impact				Failure & Impact (from Matrix 1)									
												Improbable	Possible	Probable	Imminent	Very low	Low	Medium	High	Unlikely	Somewhat likely	Likely	Very likely	Negligible	Minor	Significant	Severe		
1 / TQS - ST 1	*Eucalyptus conica* H. Deane & Maiden Fuzzy Box	F	O	17	CH – Trunk to 3 m. DW – Throughout crown	1. Deadwood 2. Crown	1. Collapse of deadwood onto pedestrians, vehicles solar array. 2. per 1.	1. 50-400. 2. 900.	1. 27 2. 17	3	1. Branches in lower – mid crown. 2. None.		1						1		1					1			M	**Priority 1** – Isolate tree within a 17 m radius fenced enclosure or design to allow the area to be separated and designated as low use. Remove weeds, mulch. **Priority 2** – Remove deadwood, or isolate tree within a 27 m radius fenced enclosure.

Tree Assessment

Trunk diameter at breast height (measured at 1.4 m) DBH 800 x 100 mm, therefore 900 mm Av., orientation E/W. Trunk straight to 3000 mm, hollow. Slight lean to east, self-corrected to upright. Crown deliquescent. Tree has recently shed a 12 m long 300 mm diameter approx. inferior first order structural branch (FOSB) from the lower crown to east at 3000 mm. The opening of the hollow branch stub extends to the trunk cavity. Deadwood remains throughout the crown. The Crown Cover is >90% and Crown Density is >90%, showing good vigour.

Comments

To minimise harm to the tree, the crown will require pruning to remove deadwood, save for branches that are hollow and contain habitat nesting sites or are potential habitat nesting sites. Here such branches should be shortened to preserve the hollows while reducing the risk of branch collapse and are to be undertaken per AS4373(2007) Pruning of amenity trees. The tree should be isolated by fencing and have the weeds removed and replaced with leaf litter mulch to 100 mm deep. Fencing should enclose the tree at a 17 m radius to protect the tree and isolate it in the event of its collapse. If the deadwood is not to be removed, a surrounding fence will need to be at a 27 m radius.

Note: Deadwood can be removed by pruning and therefore mitigating this risk. The 27 m radius is derived from the calculation that deadwood shed from a tree can extend for a radial distance of up to 1.5 times the height of a tree as the material shatters. The risk of tree collapse is the *Highest Priority* and is considered by this risk assessment.

Matrix 1. **Likelihood matrix.**

Likelihood of failure	Likelihood of impacting target			
	Very low	**Low**	**Medium**	**High**
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2. **Risk rating matrix.**

Likelihood of failure & impact	Consequences of failure			
	Negligible	**Minor**	**Significant**	**Severe**
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

3.0 METHODOLOGY

An inspection is undertaken by a visual assessment conducted from the ground and considered as part of the assessment/s of the remaining lifespan of a live tree, or durability of the remains of a dead tree where a scarred section is to be preserved.

A glossary of terms is included as Appendix C covering the description of the tree/s.

Assessment of Trees

The following criteria were recorded to reflect the current status of the trees being: Age class, Condition class, Form class, Dimensions, Crown cover (live foliage as %), Crown density (density of live foliage evident as %), vigour class and Sustainable Retention Index Value (SRIV) version 4 (IACA, 2010) of each live tree (Appendix A), where appropriate.

The age of the trees was estimated from a sound professional knowledge or research of the individual tree taxa, growth of trees within the region based on habitat, rainfall, soil type and land use practices and considered against the dimensions of each tree encountered and the limitations of its growing environment *in situ*. A tree may be described in greater detail than others where it was considered appropriate to more accurately describe the location of the wound or the circumstances which may have led to its formation.

The height of the remains of the tree was recorded using a Nikon Forestry Pro laser guided clinometer.

Assessment of Wounds to Determine Arboricultural Status of Scarred Trees

As a tree grows vascular cambium as a thin layer of dynamic cells close to the surface produces xylem to form wood on the inner side, and phloem to form bark on the outer side. The cambium grows as a continuous ring and is laid down as fibres along the trunk, stems and roots when a new growth increment layer is developed. The vascular cambium translocates nutrients in solution through the fibres from the roots to the leaves through the xylem and sugars produced in the leaves as photosynthates through the phloem and ray cells and to the roots. Their structural importance allows for strength and flexibility as energy from loading forces from the trees mass and wind movement stimulates adaptive growth and reactive growth. The shape and form of a tree is affected as wind moves along stems from the distal to proximal end dissipating and diminishing through damping through the trunk and roots and out into the ground (James *et al* 2006, Mattheck & Breloer 1994, pp. 14-19).

When the vascular cambium is disrupted a wound occurs. If the vascular cambium is severed to a sufficient depth fibres above and below will become desiccated and die forming a wound with the extent of tissue dieback often unpredictable and extending beyond the initial point of wounding. The coating of live tissue allows for dispersal of energy through damping to be distributed over the entire tree, with additional or less wood produced locally on trunk, branches and roots depending on loading forces of compression, tension, shear and torsion. The stimulus of wounding usually changes the distribution of loading forces and the growth responses from the tree which can manifest as altered growth patterns as the load bearing capacity of the tree is modified and the crown and growing conditions alter over the life of the tree. Such changes may be caused by shedding branches, hollowing from termites, fungal decay or fire, clearing of nearby trees increasing exposure to winds, branch shedding, further wounding, and root damage from excavation, soil cultivation or erosion.

When wounding occurs the trees biomechanics predispose it to attempt to restore the alignment of its fibres and to protect it from pathogens by the growth of new wood and to isolate the wound through 4 walls of defence as provided by (CODIT) Compartmentalization of Decay In Trees (Shigo 1979 and Shigo 1989, p. 45) by chemically altering surrounding wood and walling off the damage using barriers provided by existing cellular structures as Walls 1-3 and finally to conceal the wound separating it from the damage caused at the time of wounding beneath layers of new wood as Wall 4. At the time of wounding Wall 1 is formed by plugging xylem vessels vertically above and below the wound. Wall 2 is formed tangentially in growth rings by the concentration of lignin in the cells of late season's growth acting to prevent the inward spread of pathogens. Wall 3 forms at the sides of the wound from ray cells producing toxins which limits spread laterally. Wall 4 is the new wood separating the initial wound site from new growth and forms the *wound margin*.

The sides of the wound are *wound margin left* and *wound margin right* which slowly converge and usually form an oblong, circular or elliptic shape (Draper and Richards 2009). The distal and proximal ends of a wound are the *wound apex* and *wound base* respectively and may be irregular, jagged, obtuse, rounded, truncate to acute ($<90^{O}$) where the margins converge often forming a wound seam or partial occlusion (Draper and Richards 2009). The wood exposed by the removal of the bark is the *wound face* although this may be absent if a void is evident as a *cavity* or a larger void as a *hollow* (Draper and Richards 2009).

No matter what the shape of the wound the tree will ultimately attempt to align the fibres to grow over and conceal the wound to restore the cover of living wood around and along the stem to return the stem to its structural optimum, capable of receiving a uniform stress loading (Mattheck and Breloer 1994, pp. 12-16). Ultimately most margins converge and graft to conceal the *wound face* and it is then that the tree has achieved wound *occlusion* (Draper and Richards 2009). The living tissue disrupted at the time of wounding will always die, remain damaged and continue to deteriorate even when a wound is occluded by successive growth rings because trees do not heal they can only conceal the damaged cells with consecutive layers formed by each seasons growth (Mattheck and Breloer 1994, pp. 12-16).

Wound margins encroach over the wound face as new growth ring increments are added around the tree. The *wound margin depth* on the left and right sides usually deepens over time before the wound is occluded and can be measured perpendicular from the wound face to the outer edge of the trunk, or from the outer edge of the trunk to the inner edge of the void if the wound face is absent (Draper and Richards 2009). It is not uncommon for the depth of the *wound margin right* and *wound margin left* or the distances from the *initial wound margin* to the *wound margin* to be different because of reactive growth stimulated by differential loading along the stem in compression, tension, torsion or shear stimulating more wood to be laid down on the side bearing the greatest load (Mattheck and Breloer 1994, pp. 12-16). Where margins are of a similar width and depth they are usually equally loaded or may both be neutrally loaded (Mattheck 2004, p. 17).

As the wound wood margins grow across the wound face from the point of initial wounding a general differentiation in the colour of bark and its texture from surrounding unwounded tissue will sometimes be evident and can assist to indicate the extent of the width of the wound and the approximate location or extent of the *initial wound margin* (Draper and Richards 2009). However, this may become less apparent over time with wounds that have been *occluded* for long periods due to the successive growth increments added sometimes concealing the wound entirely, or on trees with thick bark.

By measuring the width of the wound between the left and right *initial wound margin* the diameter of the trunk at the time of wounding and the approximate age of the tree can be estimated. The location of a wound on a trunk is static although the diameter of the stem is increased circumferentially by rings as growth increments, hence the wound margins and wound occlusion. The circumference of the trunk and stems of large old trees increases with age and the layers may be slightly thinner over a radial distance where such growth has slowed, than for younger trees or where they are not stimulated by loading.

The tree *in situ* is expected to have a relatively moderate growth rate with a comparable average annual rainfall of 618.3 mm recorded at the nearby Tamworth Airport AWS Site No. 055325, collected from 1992-2020, open, Latitude 31.07° South, Longitude 150.84° East, Elevation 395 m (Australian Government Bureau of Meteorology, 2020) approximately 3 km away to northeast.

To differentiate between *cultural scarring*, historical scarring, recent mechanical damage or natural causes, the following were considered:

1. Age class
2. Ease of access to the location of wounding
3. Tree and its dimensions at the time of wounding
4. Extent of wounding, its symmetry (symmetrical / asymmetrical)
5. Extent of growth around wound site since initial wounding whether tree alive/dead
6. Impact of that wounding on the tree since the wounding event
7. Land use history
8. Condition class
9. Vigour class
10. Influence of its growing environment and its constraints
11. Proximity to other trees, shape and growth habit
12. Crown form
13. Shading
14. Rainfall
15. Insect damage
16. Fire
17. Soil
18. Aspect
19. Slope
20. Drainage

This Arboricultural assessment will assist Archaeologists and Aboriginal community members determine the status of scarred trees and to manage the tree/s, by eliminating natural or mechanical causes of wounding and determining the estimated remaining safe life span or works to prolong a live tree *in situ* or to conserve and protect remaining dead tree/s or relevant section/s where required.

Tree Risk Assessment

This Tree Risk Assessment section has been prepared for tree/s in High-use areas. An assessment of those tree/s undertaken as a TRAQ Level 2: Basic Assessment (Dunster *et al*, 2017, pp. 20-23). It is understood by UTMA that for the purposes of this Tree Risk Assessment section of the report the property owner Tamworth Regional Council is recognised as the Asset Manager for the site.

UTMA acts as the Tree Risk Assessor for the purposes of this section of the report to determine the status of the subject tree located in a High-use area which initiated a Level 2 Limited Assessment (Dunster *et al*, 2013, pp. 17-19) of the tree per the Tree Risk Assessment Qualification (TRAQ) system of Tree Risk Assessment applied.

The method of assessment of tree/s applied is adapted from the principles of Visual Tree Assessment (VTA) (Mattheck and Breloer, 1994) where each tree is assessed for anomalies that vary from expected average growth characteristics for the taxa when structurally sound, and a qualitative tree risk assessment using the Level 2: Basic Assessment of the Tree Risk Assessment Qualification (TRAQ) developed by the International Society of Arboriculture (ISA). The trees examined will be recorded on the UTMA Site Assessment Record – Tree Risk Assessment TRAQ. This assessment and report are valid for 12 months from the date of inspection being the period that the likelihood of failure is estimated.

A Visual Tree Assessment is limited to observations made from the ground and trees as natural and dynamic living structures inherently have component parts that may be subject to failure and collapse in full or part despite appearing free from hazards and growth anomalies. This is due primarily to interactions with the environment (biotic and abiotic) such as predation from insects, birds and decay and ongoing multi-directional loading forces (primarily compression, tension, torsion and shear) encountered from wind loading and rain. As their mass and shape changes over time, these often become foreseeable only by thorough investigative examination of the crown by an aerial inspection and/or testing of the structural branches and trunk with a Resistograph or root crown excavation examination and Resistograph testing. This is an example of TRAQ *Level 3. Advanced Assessment* (Dunster *et al*, 2017, pp. 23-33) and the assessor will make recommendations for such testing where it is considered necessary.

The *Level 2: Basic Assessment* of the Tree Risk Assessment Qualification (TRAQ) developed by the ISA considers the following process:

- Locate and identify the tree or trees to be assessed.
- Determine the targets and target zone for tree or branches of concern.
- Review site history, conditions, and species failure profile.
- Assess potential loads on the tree and its parts.
- Assess general tree health.
- Inspect the tree visually using binoculars, mallet, probes, or shovel, as desired by the arborist or as specified in the scope of work.
- Record observations of site conditions, defects and outward signs of possible internal defects and response growth.
- If necessary, recommend an advanced assessment.
- Analyse data to determine the likelihood and consequences of failure in order to evaluate the degree of risk.
- Develop mitigation options and estimate residual risk for each option.
- Develop and submit the report/documentation, including, when appropriate, advice on reinspection intervals.

The meanings for terminology used in this Tree Risk Assessment section of this report are taken from the following sources:

- IACA Dictionary for Managing Trees in Urban Environments (Draper and Richards, 2009), and
- Tree Risk Assessment Manual, 2nd edition (Dunster *et al* 2017, pp. 179-186).

Tree Pruning

Any pruning recommended in this report is to be to the Australian Standard® AS4373 *Pruning of amenity trees* and conducted in accordance with the Guide to Managing Risks of Tree Trimming and Removal Work (Safe Work Australia, 2016).

4.0 TREE ASSESSMENT

4.1 Assessment of Tree/s – Tree 1 / TQS-ST1

Tree No. / Genus & species Common Name	**1. Age Class** **Y** = Young **M** = Mature **O** = Over-mature (Senescent) **2. Age range of tree** in yrs. approx. **3. Age range of wound** in yrs. approx. **4. Date range since tree died** in yrs. approx., e.g. died, cut down, ring-barked	**Condition** **G =** Good **F =** Fair **P =** Poor **M** = Moribund **D** = Dead	**Form** **D** = Dominant **C** = Co-dominant **I** = Intermediate **S** = Suppressed **F** = Forest **E** = Emergent	**Height** in metres approx. / **Crown spread** approx. length x breadth metres / **Crown spread orientation.**	**Trunk diameter** in mm @ 1.4m, or as stated / **Trunk diameter orientation**	**Crown cover / Crown density** approx. %	**SRIV** Age, Vigour, Condition / Index Rating App A. / Remaining life expectancy 1. Long 2. Medium 3. Short
1 / TQS-ST1 *Eucalyptus conica* H. Deane & Maiden Fuzzy Box	1. O 2. >250 - <300 3.1 >150 - <250 (Wound 1) 3.2 >10 - <50 (Wounds 2 – 4) 4. N/A	F	D	17 m height, 18 m spread, NE/SW	800 x 1000, 900 Av. / E/W	90 / 90	OGVF – 5/1

Description

Eucalyptus conica H. Deane & Maiden – Fuzzy Box is a small (D. Nicolle, 1994, p. 66) to medium-sized woodland tree (Brooker and Kleinig, 1999, p. 232), 6 - 15 m (D. Nicolle, 1994, p. 66) to 10 – 20 m high (Elliot and Jones, 1986, p. 62 and NSW Flora Online, 2020) with crown spread 8 – 12 m (Elliot and Jones, 1986, p. 62). Fuzzy Box has a distribution from Wagga Wagga on the western slopes and plains to northern tablelands into Queensland (Brooker and Kleinig, 1999, p. 232) and then disjunct occurrences in Queensland from Toowoomba to Kingaroy and northeast of Chinchilla and north to the Carnarvan Range area (Brooker and Kleinig, 1994, p. 350). The wood is hard and durable used for fence posts (Elliot and Jones, 1986, p. 62), indicative of the strength of the heartwood and its resistance to weathering both above and below ground, the age of the tree and the time taken for the cavity to form.

Tree 1 (Photograph 1.0) was growing in a relatively moderate rainfall area, on well drained clay loam soils with an average annual rainfall of 618.3 mm recorded at the nearby Tamworth Airport AWS Site No. 055325, collected from 1992-2020 (Australian Government Bureau of Meteorology, 2020) approximately 3 km away to northeast. The tree is expected to have grown at a rate typical for the species with an estimated age of >250 - <300 years old. However, this has not been confirmed by cross referencing with other research material such as early aerial photographs. The site is moderately sloping and appears to be well drained which suites the cultivation of this taxa (Elliot and Jones, 1986, p. 62).

The tree has a trunk to 3 m, straight with a very slight lean to the east which has self-corrected to upright over time (Photograph 4.0). Crown deliquescent. Crown has shed one 300 mm diameter approx. inferior first order structural branch (FOSB) to east, at 3 m. Trunk hollow with 4 wounds, 1 older wound to west on upper trunk expected to be of Aboriginal cultural origin, and 3 more recent wounds on the lower trunk, expected to be derived from abrasion impact events from grazing livestock.

Wound 1 (W1)

Trunk wound, narrow, linear, vertical, symmetrical, on west side (Photographs 1.0, 2.0 and 4.0). Wound extending from 1400 mm to 2400 mm and 400 mm at widest at 1800 mm. Wound margins extending from 1540 mm to 2200 mm and 70 mm at widest at 1800 mm. Wound face absent extending to hollow trunk with a detached would face section recovered from the cavity, examined and returned. Depth of wound margins, Right 200 mm proximally and distally, Left margin 200 mm proximally and distally. Left and right wound margins entire. Wound apex and base acute. Initial wound margins: not evident. Wound affects approx. 10-15% of trunk circumference. Wound expected to be >150-<250 years old based on extent of wound margin development and extent of trunk hollow. The original trunk with a slight lean to east would have contained bark growing under tension with the fibres straight and strong in the location where the artifact was extracted.

Cause: Aboriginal cultural origin.

Wounds 2 – 4 (W2 – W4)

Wound 2 - Trunk wound, basal to north, broad, irregular and asymmetrical (Photographs 2.0, 3.0 and 4.0). Wounds extending to approx. 700 mm and 450 mm wide with well-developed wound margins. Wound base truncated at ground and apex jagged to irregular. Wound face entire with negligible weathering as delignification, indicative of the contemporary nature of the wounding. Depth of margins, Right 10-20 mm. Initial wound margins: not evident. Left and right wound margins entire. Each wound affects approx. 3-5% of trunk circumference. Wounds >10-<50 years old.

Wounds 3 and 4 - Trunk wounds, 2 small wounds to west, narrow irregular and asymmetrical (Photograph 2.0). Wounds extend from 100 mm and 350 mm approx. above ground, up to 150 mm and 200 mm long and 15 mm 20 mm wide approx. with well-developed wound margins, respectively. Wound base and apex acute. Wound face entire with negligible weathering as delignification, indicative of the contemporary nature of the wounding. Depth of margins, Right 10-20 mm. Initial wound margins: not evident. Left and right wound margins entire. Wound affects approx. 10% of trunk circumference. Wound >10-<50 years old.

Cause: Due to the young age of the wounds, irregular and asymmetrical shapes, negligible weathering of the wound face, it is most likely these wounds were formed by abrasion impact events from the grazing activity of livestock.

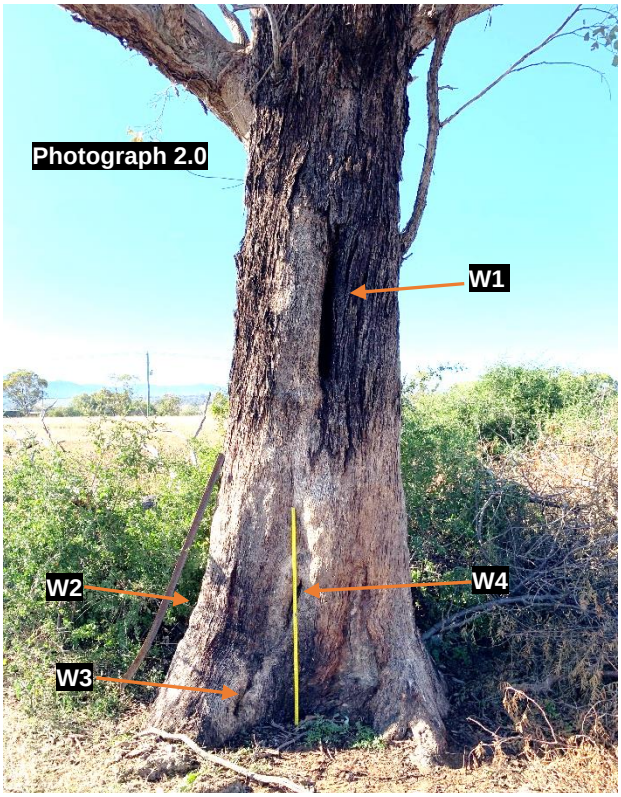
Risks to tree and mitigation

Damage from fire, fungal decay and termites. Collapse from hollow trunk, although the tree is vigorous with well-developed wound margins indicative of the growth of new wood likely to sustain the tree against the continuing decay of the trunk. The protection of the tree and its growing environment by the removal of weeds as competition and the application of mulch will greatly assist its' vigour. Protection of the roots from soil compaction by isolating the tree within a 17 m radius of the trunk using a fenced enclosure or design to allow the area to be separated and designated as low use. Remove weeds manually to protect tree roots and poison weeds using bush regeneration techniques. Post weed removal - Mulch to 100 mm deep with leaf litter mulch.

Tree Protection During Construction

If Tree 1 / TQS-ST1 is to be retained, it will require protection subject to AS4970 (2009) Section 3 and will require a radial Tree Protection Zone (TPZ) fence measured from centre of trunk of 12 x 900 mm DBH which is 10.8 m. The TPZ fence should be constructed of Temporary Fencing Panels to enclose the tree for the duration of the construction works. Weeding and mulching should be undertaken prior to the installation of the TPZ fence.



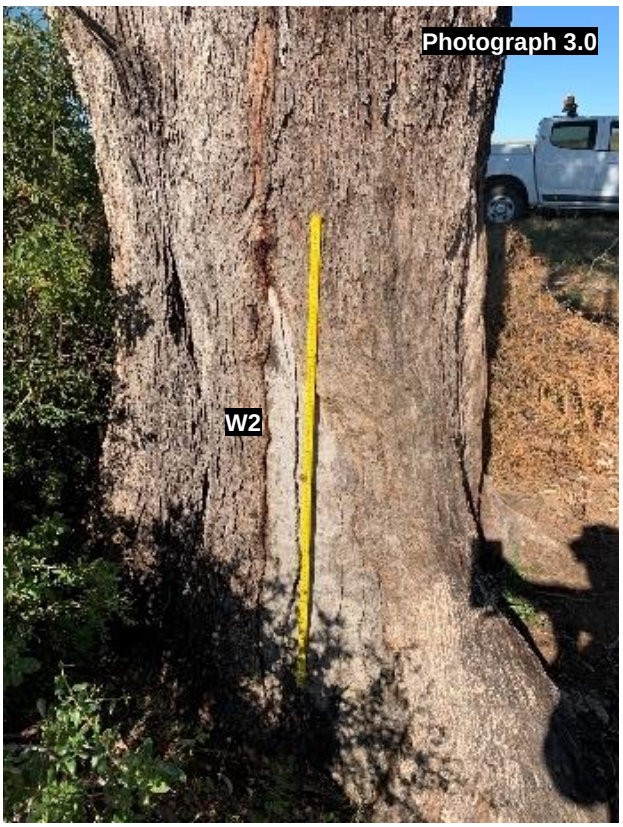


Photograph 1.0 Taken 6/07/2020 by Danny Draper. View to east of Tree 1 / TQS-ST1 *Eucalyptus conica* H. Deane & Maiden. Wounds 1 (W1) on west side of the trunk indicated with an orange arrow and shown with a yellow 1 m folding ruler.

Photograph 2.0 Taken 6/07/2020 by Danny Draper. View to east of Tree 1 / TQS-ST1 *Eucalyptus conica* H. Deane & Maiden. Wounds 1, 3 and 4 (W1, W3 and W4) on west side of the trunk and Wound 2 (W2) on north side of trunk indicated with orange arrows and shown with a yellow 1 m folding ruler.

Photograph 3.0 Taken 6/07/2020 by Danny Draper. View to south of Tree 1 / TQS-ST1 *Eucalyptus conica* H. Deane & Maiden. Wound 2 (W1) on north side of trunk, showing shallow wound margins and negligible weathering of the wound face, shown with a yellow 1 m folding ruler.

Photograph 4.0 Taken 6/07/2020 by Danny Draper. View to south of Tree 1 / TQS-ST1 *Eucalyptus conica* H. Deane & Maiden. Wounds 1 (W1) and Wound 2 (W2) on west and north sides of trunk, respectively. Trunk shows slight self-corrected lean to east.





5.0 CONCLUSION

This is provided in tabular form and summarizes the key information for wound causation assessment.

Tree No. / Archaeological reference	Age of Tree **Age range of tree** in yrs. approx.	Age of Scar **Age range of wound** in yrs. approx.	Likely origin of Scar/s
1 / TQS-ST1	>250 - <300	1. >150- <250 (Wound 1) 2. >10 - <50 (Wounds 2- 4)	1. Aboriginal Cultural origin. (Wound 1) 2. Abrasion impact event from livestock. (Wounds 2- 4)



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DISCLAIMER

The author and Urban Tree Management take no responsibility for actions taken and their consequences, contrary to those expert and professional instructions given as recommendations pertaining to safety by way of exercising our responsibility to our client and the public as our duty of care commitment, to mitigate or prevent hazards from arising, from a failure moment in full or part, from a structurally deficient or unsound tree or a tree likely to be rendered thus by its retention and subsequent deterioration from modification/s to its growing environment either existing or proposed, either above or below ground, contrary to our advice.

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Appendix A

Matrix - Sustainable Retention Index Value (SRIV) ©

Version 4, 2010
Developed by IACA – Institute of Australian Consulting Arboriculturists www.iaca.org.au

The matrix is to be used with the value classes defined in the Glossary for Age / Vigour / Condition.
An index value is given to each category where ten (10) is the highest value.

Age Class	Vigour Class and Condition Class					
	Good Vigour & Good Condition (GVG)	Good Vigour & Fair Condition (GVF)	Good Vigour & Poor Condition (GVP)	Low Vigour & Good Condition (LVG)	Low Vigour & Fair Condition (LVF)	Low Vigour & Poor Condition (LVP)
	Able to be retained if sufficient space available above and below ground for future growth. No remedial work or improvement to growing environment required. May be subject to high vigour. Retention potential - Medium – Long Term.	Able to be retained if sufficient space available above and below ground for future growth. Remedial work may be required or improvement to growing environment may assist. Retention potential - Medium Term. Potential for longer with remediation or favourable environmental conditions.	Able to be retained if sufficient space available above and below ground for future growth. Remedial work unlikely to assist condition, improvement to growing environment may assist. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	May be able to be retained if sufficient space available above and below ground for future growth. No remedial work required, but improvement to growing environment may assist vigour. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	May be able to be retained if sufficient space available above and below ground for future growth. Remedial work or improvement to growing environment may assist condition and vigour. Retention potential - Short Term. Potential for longer with remediation or favourable environmental conditions.	Unlikely to be able to be retained if sufficient space available above and below ground for future growth. Remedial work or improvement to growing environment unlikely to assist condition or vigour. Retention potential - Likely to be removed immediately or retained for Short Term. Potential for longer with remediation or favourable environmental conditions.
(Y) Young	**YGVG - 9** **Index Value 9** Retention potential - Long Term. Likely to provide minimal contribution to local amenity if height <5 m. High potential for future growth and adaptability. Retain, move or replace.	**YGVF - 8** **Index Value 8** Retention potential - Short – Medium Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5 m. Medium-high potential for future growth and adaptability. Retain, move or replace.	**YGVP - 5** **Index Value 5** Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5 m. Low-medium potential for future growth and adaptability. Retain, move or replace.	**YLVG - 4** **Index Value 4** Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5 m. Medium potential for future growth and adaptability. Retain, move or replace.	**YLVF - 3** **Index Value 3** Retention potential - Short Term. Potential for longer with improved growing conditions. Likely to provide minimal contribution to local amenity if height <5m. Low-medium potential for future growth and adaptability. Retain, move or replace.	**YLVP - 1** **Index Value 1** Retention potential - Likely to be removed immediately or retained for Short Term. Likely to provide minimal contribution to local amenity if height <5 m. Low potential for future growth and adaptability.
(M) Mature	**MGVG - 10** **Index Value 10** Retention potential - Medium - Long Term.	**MGVF - 9** **Index Value 9** Retention potential - Medium Term. Potential for longer with improved growing conditions.	**MGVP - 6** **Index Value 6** Retention potential - Short Term. Potential for longer with improved growing conditions.	**MLVG - 5** **Index Value 5** Retention potential - Short Term. Potential for longer with improved growing conditions.	**MLVF - 4** **Index Value 4** Retention potential - Short Term. Potential for longer with improved growing conditions.	**MLVP - 2** **Index Value 2** Retention potential - Likely to be removed immediately or retained for Short Term.
(O) Over-mature	**OGVG - 6** **Index Value 6** Retention potential - Medium - Long Term.	**OGVF - 5** **Index Value 5** Retention potential - Medium Term.	**OGVP - 4** **Index Value 4** Retention potential - Short Term.	**OLVG - 3** **Index Value 3** Retention potential - Short Term. Potential for longer with improved growing conditions.	**OLVF - 2** **Index Value 2** Retention potential - Short Term.	**OLVP - 0** **Index Value 0** Retention potential - Likely to be removed immediately or retained for Short Term.

Appendix B

Glossary

From
Dictionary for Managing Trees in Urban Environments
Institute of Australian Consulting Arboriculturists (IACA) 2009, CSIRO Publishing.

Wounds

Abrasion Wound *Mechanical wound* causing *laceration* of tissue by an abrasive impact *episode* e.g. grazed by a motor vehicle or the continuous action of the rubbing of *crossed branches* or stems where no graft has formed.

Basal Trunk Wound A wound on the trunk extending to the *root crown* where the base of the wound is open at the ground and usually truncated. Dependent upon the width of its base such a wound may not become *occluded*.

Blaze A wound cut into a tree usually to the sapwood and sometimes extending to heartwood to create a marker point e.g. by a surveyor, the *wound face* may be further incised or painted to denote additional information.

Branch Core After a branch fails or is removed, this is the remaining branch section within the connecting branch or trunk walled off by compartmentalisation.

Branch Tear *See Branch Tear Out.*

Branch Tear Out Dislodging of a branch from its point of attachment where it is torn away from the *branch collar* snapping the *branch tail* causing a *laceration*, usually to the underside of the *branch union* of the branch or trunk to which it was attached forming a *tear out wound*.

Branch Tear Wound *See Tear Out Wound.*

Callus Wood Undifferentiated and unlignified wood that forms initially after wounding around the margins of a wound separating damaged existing wood from the later forming lignified wood or *wound wood*.

Canker A *wound* created by repeated localised killing of the *vascular cambium* and bark by wood *decay* fungi and bacterium usually marked by concentric disfiguration. The wound may appear as a depression as each successive *growth increment* develops around the *lesion* forming a *wound margin* (Shigo 1991, p. 140, Keane *et al* 2000, p. 332).

Cavity A usually shallow void often localized initiated by a *wound* and subsequent *decay* within the trunk, branches or roots, or beneath bark, and may be enclosed or have one or more opening.

Decay Process of degradation of wood by microorganisms (Australian Standard 2007, p. 6) and fungus.

Delaminate A *mechanical wound* caused when the bark is stripped from a tree, usually from the trunk as a continuous sheet back to the vascular cambium. This may occur from an impact or abrasion *episode* such as a collision with a motor vehicle and the tree may become *ringbarked*. See also *Partially Delaminated*.

Delamination The separation of fibres often evident as longitudinal splitting of wood (Lonsdale 1999, p. 313).

Delignification The decomposition of *lignin* from *wood* by chemical deterioration, resulting in loss of strength, evident by separation of fibres into hair like strands. See also *Lignification*.

Depth of Margin Distance from outer trunk perpendicular to the *wound face*. This may assist in determining the age of a wound.

Dieback Wound Wounding where *dieback* extends beyond a branch collar as with *natural pruning* and extends to other branches, trunk or roots. See also *Secondary Crown* and *Stag-headed*.

Enclosed Wound Wound with a perimeter of *wound wood* with a well-defined apex, base and margins and often evident on an older wound. On a pruned branch that is rounded the enclosing wound wood from the branch collar may be circular with no definite apex or base evident. However, on a pruned branch where the *wound face* is oval in shape due to *reaction wood*, the enclosing *wound wood* from the branch collar may form a definite apex, base or margins.

Environmental Wounding/Damage Wounding inflicted by environmental factors or modifications to the growing *environment* of a tree, e.g. sun-scald, drought, fire, water logging, wind damage to leaves, branches, bark or roots, phytotoxic damage from chemicals, or air, soil or water pollution.

Fire Wound Wounding caused by fire. Such wounds may cause initial damage or may be secondary from a previous wounding *episode*/s. Some fire damage may be superficial or may destroy a tree in full or part rendering it potentially vulnerable to failure. Note: fire damaged trees can be potentially hazardous and should be assessed carefully.

Hollow A large void initiated by a *wound* forming a *cavity* in the trunk, branches or roots and usually increased over time by *decay* or other contributing factors, e.g. fire, or fauna such as birds or insects e.g. ants or termites. A hollow can be categorized as an *Ascending Hollow* or a *Descending Hollow*.

Horizontal Wound Usually superficial horizontal wounding from insects burrowing between bark layers and revealed by decorticating bark. Often evident on smooth bark Eucalypts.

Impact Wound *Mechanical wound* caused by an impact *episode* e.g. collision by a motor vehicle.

Incision Wound caused by cutting or engraving. See also *Laceration*.

Increment strip A linear, usually narrow, *fluted* section of *adaptive wood,* forming in a place of high *stress* indicating the pattern of *force flow* (Mattheck 2004, p. 140). Evident as lighter coloured bark usually occurring around the edges of a *notch* or *branch stub*, along a *buttress*, or along a *sharp-edged rib*.

Initial Wound Margin The site of initial wounding often evident as a faint line of discoloured bark or bark of a different texture to adjacent undamaged trunk. This may assist in determining the age of a wound.

Insect Wound Wounding to any part of a tree caused by insect activity, e.g. borers and termites.

Laceration Wound caused by tearing. See also *Incision*.

Lightning Strike Wound A wound from a lightning strike. Such a wound may kill a tree outright or cause it to catch fire, or may destroy the tree in full or part, or no injury may be evident and a tree gradually declines through resulting *stress*. Bark may be exploded from the tree by pressure radiating from the core of the lightning path resulting in further compounded damage through water heating and steam explosions in the tissues and the electrical disruption of living cells (Coder 2004, pp. 35-44).

Mechanical Wound Wounding inflicted by abrasion e.g. by motor vehicles, grass mowing equipment, grazing by horses, cows or birds (parrots); impact e.g. by motor vehicle collisions; drilling e.g. with increment cores, resistographs, cable bracing, hanging pots, hammocks etc.; branch tearing e.g. from wind damage, collision from falling branches, vandalism; and root severance e.g. root pruning for excavation for building or utility services or for agricultural cultivation.

Open Wound Wound with poor to non-existent perimeter or *callus wood* or *wound wood* on an older wound without well-defined apex, base or margins and often this will be associated with a recent wounding *episode* or an older episode on a senescent tree or a tree in *poor condition* or of *low vigour*, or where repeated wounding episodes such as inflicted by ongoing borer activity damages and continually alters wound perimeters, or repeated scalping of exposed roots by lawn mowing equipment.

Occlusion Growth processes where *wound wood* develops to enclose the *wound face* by the merging of *wound margins* concealing the *wound* and restoring the growing surface of the structure with each *growth increment* gradually realigning *fibres* in the wood longitudinally along the stem to maximise uniform stress loading.

Partial Occlusion *Wound wood* growth that encloses some of the *wound face* by the merging and *grafting* of some sections of the *wound margins*. Usually evident by reduced *wound face* width and indicated where an *apex* or *base* is *acute* with the vertical extent often indicated by the length of an *occlusion seam*.

Partially Bridged Occlusion *Wound wood* partly forming an *occlusion* by joining areas of the *wound margins* across the *wound face* at point/s other than the base or apex and may form an *occlusion seam*.

Pruning Wound A wound created by the act of *pruning*.

Ram's Horning *Wound wood* that becomes curled inward and can wrap around itself as it crosses a void such as a *cavity* and may succumb to cracking with those wounds susceptible to further infestation by *decay* pathogens.

Scarred Tree A tree containing a wound of cultural or scientific interest, inflicted initially for a specific purpose, e.g. by indigenous people to extract implements or carved as a marker or with a pattern for ceremonial purposes, or as a marker and *blaze* by a surveyor or explorer, or from an accidental *wound* that has not *occluded*.

Stepped Incision A localised area of deeper wounding often extending to the heartwood, usually proximally within a *blaze*, removing a vertical semi-circular wedge like section from the *wound face* with a horizontal bench like structure formed by deep cuts as its base. Such wound sections usually taper distally and may be cut around the outer edges to assist removal of the semi-circular wedge, and likely undertaken to inhibit regrowth.

Structural Wound Any wound occurring on a tree as a result of a structural failure e.g. branch splitting or *hazard beam*, diminishing its stability in full or part.

Succession Wound Preceding layers of failed wound margin/s forming a step like sequence away from the *wound face*, where present, to the current wound margin/s indicating repeated cycles of formation and failure of *CODIT Wall 4*.

Sun Scald Wounding Wounding usually on the upper side of branches after sudden exposure to sunlight especially in summer e.g. after excessive pruning of the upper crown, or following storm damage stripping foliage or branches e.g. *Ficus spp.*

Survey Marker Wound *See Blaze.*

Tear Out *See Branch Tear Out.*

Tear Out Wound A wound of usually concave shape created by a *branch tear out*.

Wound Damage inflicted upon a tree through injury to its living cells, from biotic or abiotic causes, e.g. where *vascular cambium* has been damaged by branch breakage, impact or insect attack. Some wounds *decay* and cause *structural deterioration* or *defects*. Trees of *normal vigour* are able to resist and contain infection by walling off areas within the wood by *compartmentalization*. See *Compartmentalization Of Decay In Trees (CODIT)*. An *occlusion* may eventually conceal a wound but the enclosed *defect* remains internally and *decay* may continue to develop further weakening the *heartwood* and *sapwood* compromising the tree's *structural integrity*. The cause of a wound may be accidental e.g. *branch tear out* or deliberate e.g. *carved tree*.

Wound Apex The distal end of a wound. The shape may be acute, irregular, jagged, obtuse, rounded, or truncate.

Wound Apex Acute Apex of a wound that is tapering and the *occlusion* interface angle is less than $<90^{O}$.

Wound Apex Irregular The *wound wood* growth at the apex mostly interrupted forming an edge that is not uniform or jagged. Often this may be influenced by a *successional wound* resulting in disproportionate development of *callous wood* and *wound wood.*

Wound Apex Jagged The *wound wood* growth or tissue damaged initially at the apex that is uneven and likely to have been caused by laceration.

Wound Apex Obtuse Apex of a wound that is tapering and the *occlusion* interface angle is greater than $>90^{O}$.

Wound Apex Rounded The *wound wood* growth at the apex that is curved.

Wound Apex Truncate The *wound wood* growth or tissue damaged initially at the apex that is even and likely to have been caused by incision.

Wound Base The proximal end of a wound. The shape may be acute, irregular, jagged, obtuse, rounded, or truncate.

Wound Base Acute Base of wound that is tapering and the *occlusion* interface angle is less than <90°.

Wound Base Irregular The *wound wood* growth at the base mostly interrupted forming an edge that is not uniform or jagged. Often this may be influenced by a *successional wound* resulting in disproportionate development of *callous wood* and *wound wood.*

Wound Base Jagged The *wound wood* growth or tissue damaged initially at the base that is uneven and likely to have been caused by laceration.

Wound Base Obtuse Base of wound that is tapering and the *occlusion* interface angle is greater than >90°.

Wound Base Rounded The *wound wood* growth at the base that is curved.

Wound Base Truncate The *wound wood* growth or tissue damaged initially at the base that is even and likely to have been caused by incision.

Wound Face Surface area of tissue exposed by injury, e.g. bark, sapwood, heartwood.

Wound Face Cracks Horizontal Transverse cracks in a *wound face* indicative of failure from *tension* force (Mattheck & Breloer 1994, p. 183).

Wound Face Cracks Vertical Longitudinal cracks in a *wound face* indicative of failure from *compression* force (Mattheck & Breloer 1994, p. 183).

Wound Face Entire Surface of exposed tissue is uniform without damage extending to a different layer or unaffected by borers or decay, e.g. possibly described as *wound face* entire to dead sapwood.

Wound Face Incomplete Surface of exposed tissue is not uniform with damage extending to different layers or affected by borers or decay, e.g. possibly described as *wound face incomplete* with cavity at apex. See also *Wound face entire*.

Wound Face Exposed Heartwood Wound extending to reveal the *heartwood*, or has deteriorated through *decay* to reveal this layer of wood.

Wound Face Exposed Sapwood Wound extending to reveal the sapwood, or has deteriorated through *decay* to reveal this layer of wood.

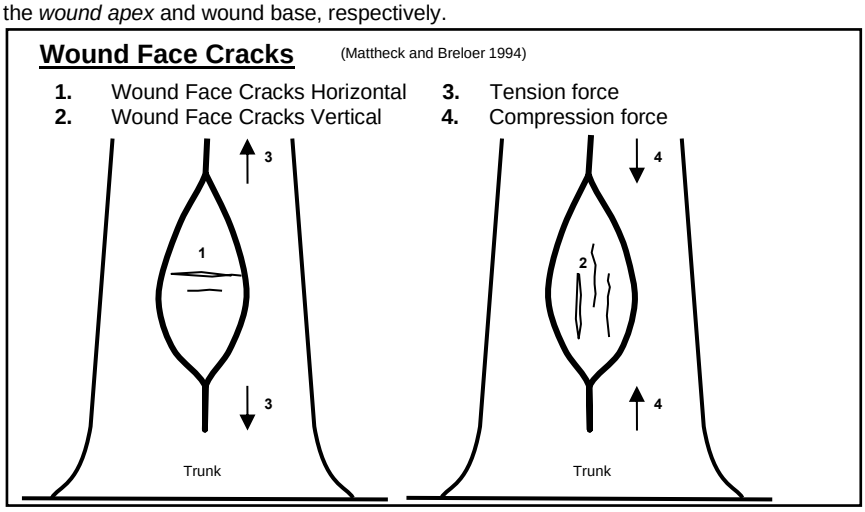
Wound Margin The left and right sides of a *wound* as bound by the alignment of fibres along a stem or root longitudinally, being either the remaining undamaged living cells and new *callus wood* and *wound wood* on older wounds. Here the fibres are usually formed from *meristematic* cells. A wound margin may be circular on a *pruning wound* or form around the perimeter of a *canker*.

Wound Margin Entire The *wound wood* growth in the margin is mostly uninterrupted forming a uniform edge.

Wound Margin Irregular The *wound wood* growth in the margin is mostly interrupted and forms an edge that is not uniform e.g. where repeated wounding *episode*s such as inflicted by ongoing borer activity damages and continually alters the *wound perimeter* with *callus wood* and *wound wood*. See also *Successional Wound*.

Wound Margin Left The left side of a wound margin when the distal and proximal ends of the wound is known, to determine the *wound apex* and *wound base*, respectively.

Wound Margin Right The right side of a wound margin when the distal and proximal end of the wound is known, to determine the *wound apex* and wound base, respectively.



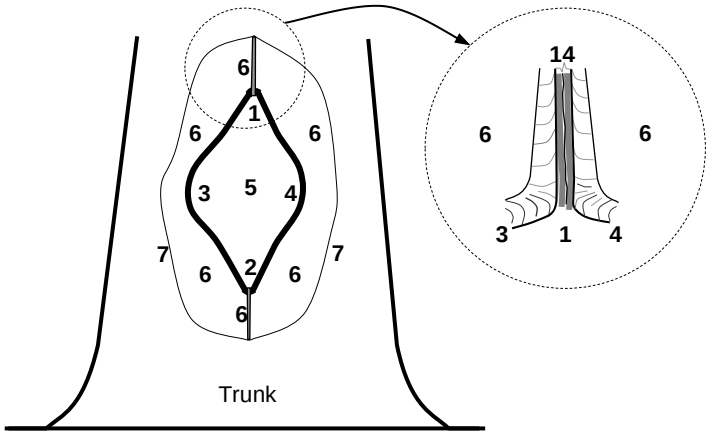
Wound Margin Width Distance from *wound margin* to the site of initial wounding. Where evident the *initial wound margin* may be identified by discoloured bark or bark of a different texture to adjacent undamaged trunk. This may also assist in determining the age of a wound.

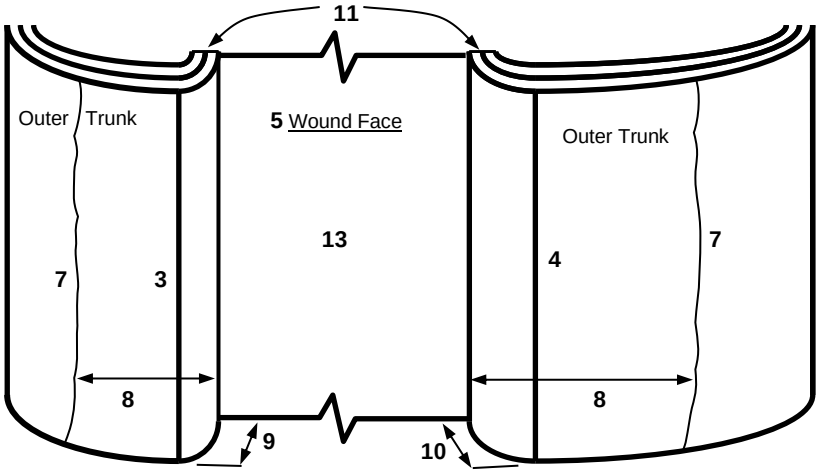
Wound Wood Aged *callus wood* around the margins of a wound that becomes differentiated to form *CODIT Wall 4* producing new lignified wood. This wood may grow to surround a wound and may eventually develop to enclose the wound by *occlusion*.

Wound Diagrams

Wound Parts

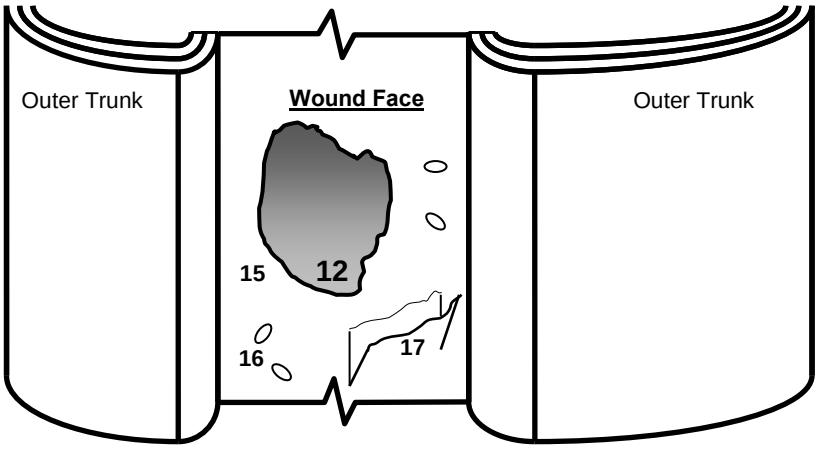
1. Apex
2. Base
3. Wound Margin Left
4. Wound Margin Right
5. Wound Face
6. Partial Occlusion
7. Initial Wound Margin
8. Margin Width
9. Left Margin Depth
10. Right Margin Depth
11. Wound Wood
12. Cavity
13. Wound Face Entire
14. Occlusion Seam





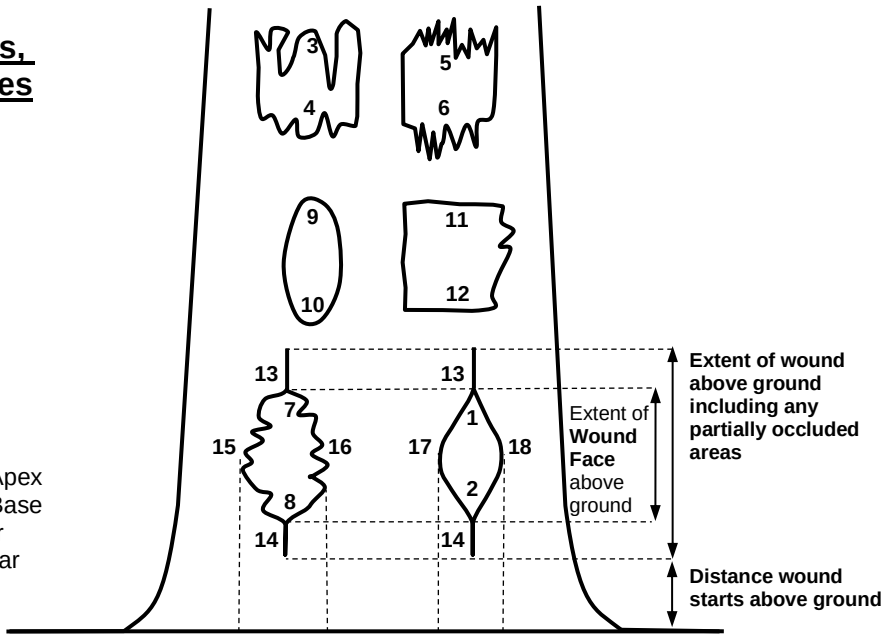
Examples of other Wound Faces

15. Wound face extending from dead sapwood to cavity in heartwood.
16. Oval shaped borer exit holes evident indicative of Longicorn Borer (Family Cerambycidae).
17. Linear laceration as made by an axe.



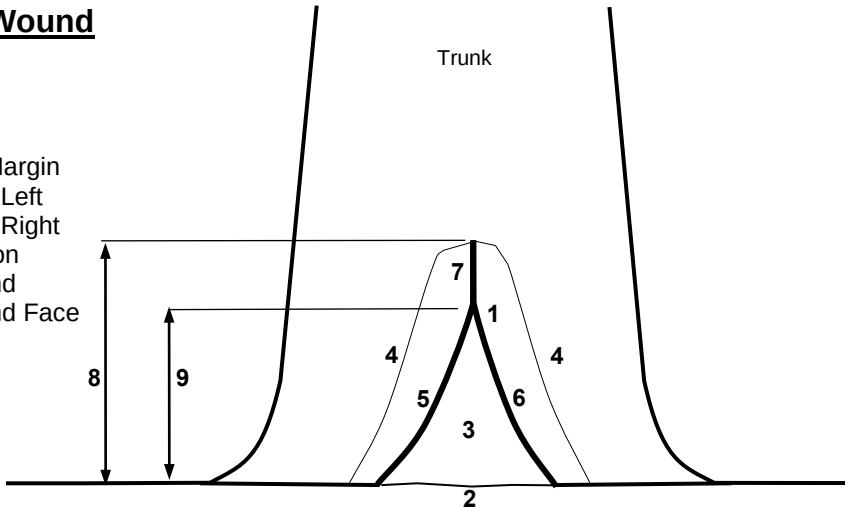
Wounds, Margins, Apexes and Bases

1. Apex Acute
2. Base Acute
3. Apex Irregular
4. Base Irregular
5. Apex Jagged
6. Base Jagged
7. Apex Obtuse
8. Base Obtuse
9. Apex Rounded
10. Base Rounded
11. Apex Truncate
12. Base Truncate
13. Partially Occluded Apex
14. Partially Occluded Base
15. Left Margin Irregular
16. Right Margin Irregular
17. Left Margin Entire
18. Right Margin Entire



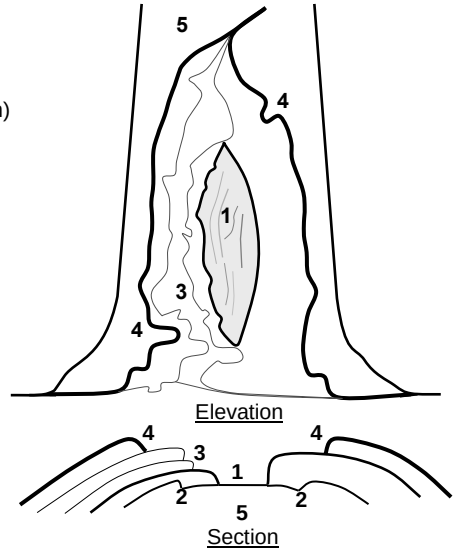
Basal Trunk Wound

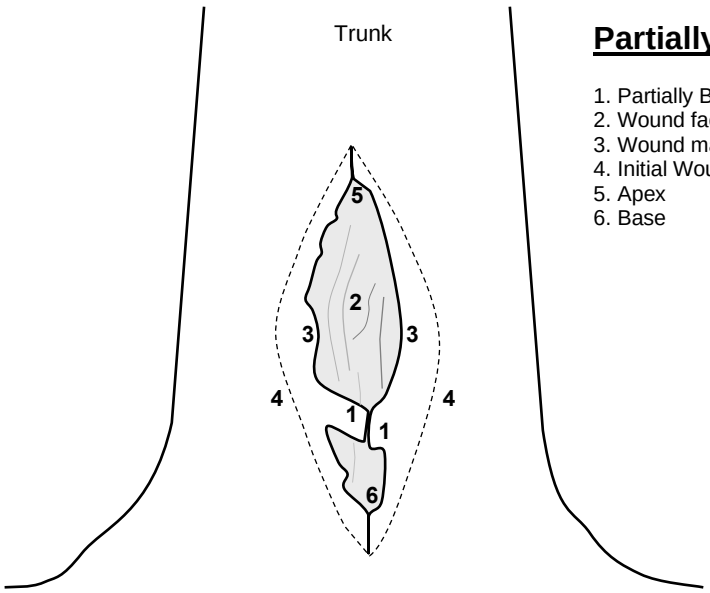
1. Apex
2. Base
3. Wound Face
4. Initial Wound Margin
5. Wound Margin Left
6. Wound Margin Right
7. Partial Occlusion
8. Extent of Wound
9. Extent of Wound Face



Successional Wound

1. Initial wound face
2. Initial wound margins (concealed when viewed in Elevation)
3. Successive wound margins
4. Wound margins (current)
5. Trunk





Partially Bridged Occlusion

1. Partially Bridged Occlusion
2. Wound face
3. Wound margins
4. Initial Wound Margins
5. Apex
6. Base

Condition of Trees

Condition A tree's *crown form* and growth habit, as modified by its *environment* (aspect, suppression by other trees, soils), the *stability* and *viability* of the *root plate*, trunk and structural branches (first (1st) and possibly second (2nd) order branches), including structural defects such as wounds, cavities or hollows, *crooked* trunk or weak trunk/branch junctions and the effects of predation by pests and diseases. These may not be directly connected with *vigour* and it is possible for a tree to be of *normal vigour* but in *poor condition*. Condition can be categorized as *Good Condition*, *Fair Condition*, *Poor Condition* and *Dead*.

Good Condition Tree is of good habit, with *crown form* not severely restricted for space and light, physically free from the adverse effects of *predation* by pests and diseases, obvious instability or structural weaknesses, fungal, bacterial or insect infestation and is expected to continue to live in much the same condition as at the time of inspection provided conditions around it for its basic survival do not alter greatly. This may be independent from, or contributed to by vigour. See also *Condition*, *Fair Condition* and *Poor Condition*.

Fair Condition Tree is of good habit or *misshapen*, a form not severely restricted for space and light, has some physical indication of *decline* due to the early effects of *predation* by pests and diseases, fungal, bacterial, or insect infestation, or has suffered physical injury to itself that may be contributing to instability or structural weaknesses, or is faltering due to the modification of the *environment* essential for its basic survival. Such a tree may recover with remedial works where appropriate, or without intervention may stabilise or improve over time, or in response to the implementation of beneficial changes to its local environment. This may be independent from, or contributed to by vigour. See also *Condition*, *Good Condition* and *Poor Condition*.

Poor Condition Tree is of good habit or *misshapen*, a form that may be severely restricted for space and light, exhibits symptoms of advanced and *irreversible decline* such as fungal, or bacterial infestation, major die-back in the branch and *foliage crown*, *structural deterioration* from insect damage e.g. termite infestation, or storm damage or lightning strike, ring barking from borer activity in the trunk, root damage or instability of the tree, or damage from physical wounding impacts or abrasion, or from altered local environmental conditions and has been unable to adapt to such changes and may decline further to death regardless of remedial works or other modifications to the local *environment* that would normally be sufficient to provide for its basic survival if in *good* to *fair* condition. Deterioration physically, often characterised by a gradual and continuous reduction in vigour but may be independent of a change in vigour, but characterised by a proportionate increase in susceptibility to, and *predation* by pests and diseases against which the tree cannot be sustained. Such conditions may also be evident in trees of advanced senescence due to normal phenological processes, without modifications to the growing environment or physical damage having been inflicted upon the tree. This may be independent from, or contributed to by vigour. See also *Condition*, *Good Condition* and *Fair Condition*.

Moribund Advanced state of decline, dying or nearly dead.

Dead Tree is no longer capable of performing any of the following processes or is exhibiting any of the following symptoms;
Processes
Photosynthesis via its foliage crown (as indicated by the presence of moist, green or other coloured leaves);
Osmosis (the ability of the root system to take up water);
Turgidity (the ability of the plant to sustain moisture pressure in its cells);
Epicormic shoots or *epicormic strands* in Eucalypts (the production of new shoots as a response to stress, generated from latent or adventitious buds or from a *lignotuber*);
Symptoms
Permanent leaf loss;
Permanent wilting (the loss of turgidity which is marked by desiccation of stems leaves and roots);
Abscission of the *epidermis* (bark desiccates and peels off to the beginning of the sapwood).

Removed No longer present, or tree not able to be located or having been cut down and retained on a site, or having been taken away from a site prior to site inspection.

Periods of Time

Periods of Time The life span of a tree in the urban environment may often be reduced by the influences of encroachment and the dynamics of the environment and can be categorized as *Immediate*, *Short Term*, *Medium Term* and *Long Term*.

Immediate An *episode* or occurrence, likely to happen within a twenty-four (24) hour period, e.g. tree failure or collapse in full or part posing an imminent danger. See also *Short Term*, *Medium Term* and *Long Term*.

Short Term A period of time less than <1 – 15 years. See also *Periods of Time*, *Immediate*, *Medium Term* and *Long Term*.

Medium Term A period of time 15 – 40 years. See also *Periods of Time*, *Immediate*, *Short Term* and *Long Term*.

Long Term A period of time greater than >40 years. See also *Periods of Time*, *Immediate*, *Medium Term* and *Short Term*.

Vigour

Vigour Ability of a tree to sustain its life processes. This is independent of the *condition* of a tree but may impact upon it. Vigour can appear to alter rapidly with change of seasons (seasonality) e.g. dormant, deciduous or semi-deciduous trees. Vigour can be categorized as *Normal Vigour, High Vigour*, *Low Vigour* and *Dormant Tree Vigour*.

Normal Vigour Ability of a tree to maintain and sustain its life processes. This may be evident by the *typical* growth of leaves, *crown cover* and *crown density*, branches, roots and trunk and *resistance* to *predation*. This is independent of the *condition* of a tree but may impact upon it, and especially the ability of a tree to sustain itself against predation. See also *Vigour*, *Low Vigour* and *High Vigour*.

High Vigour *Accelerated growth* of a tree due to incidental or deliberate artificial changes to its growing *environment* that are seemingly beneficial, but may result in *premature aging* or failure if the favourable conditions cease, or promote *prolonged senescence* if the favourable conditions remain, e.g. water from a leaking pipe; water and nutrients from a leaking or disrupted sewer pipe; nutrients from animal waste, a tree growing next to a chicken coop, or a stock feed lot, or a regularly used stockyard; a tree subject to a stringent watering and fertilising program; or some trees may achieve an extended lifespan from continuous *pollarding* practices over the life of the tree.

Low Vigour Reduced ability of a tree to sustain its life processes. This may be evident by the *atypical* growth of leaves, reduced *crown cover* and reduced *crown density*, branches, roots and trunk, and a deterioration of their functions with reduced *resistance* to *predation*. This is independent of the *condition* of a tree but may impact upon it, and especially the ability of a tree to sustain itself against predation. See also *Vigour*, *Normal Vigour* and *High Vigour*.

Dormant Tree Vigour Determined by existing turgidity in lowest order branches in the outer extremity of the crown, with good bud set and formation, and where the last *extension growth* is distinct from those most recently preceding it, evident by bud scale scars. Normal vigour during dormancy is achieved when such growth is evident on a majority of branches throughout the crown.

Good Vigour See *Normal Vigour*.

Poor Vigour See *Low Vigour*.

Health A tree's *vigour* as exhibited by *crown density*, *crown cover*, leaf colour, presence of epicormic shoots ability to withstand *predation* by pests and diseases, *resistance* and the degree of *dieback*.

Age of Trees

Age Most trees have a stable biomass for the major proportion of their life. The estimation of the age of a tree is based on the Knowledge of the expected lifespan of the taxa in situ divided into three distinct stages of measurable biomass, when the exact age of the tree from its date of cultivation or planting is unknown and can be categorized as *Young*, *Mature* and *Over-mature* (British Standards 1991, p. 13, Harris *et al*, 2004, p. 262).

Young Tree aged less than <20% of life expectancy, *in situ*. See also *Age*, *Mature* and *Over-mature*.

Mature Tree aged 20-80% of life expectancy, *in situ*. See also *Age*, *Young* and *Over-mature*.

Over-mature Tree aged greater than >80% of life expectancy, *in situ,* or *senescent* with or without reduced *vigour*, and declining gradually or rapidly but irreversibly to death. See also *Age*, *Young* and *Mature*.

Premature Aging Apparent hastened aging and deterioration of a tree where it has been subject to conditions or practices adverse to expected normal growth, resulting in a *spiral of decline*. The following are examples of processes that may start such cycles:

- Top lopping of a mature tree
- In a new car park, the excavation of soil severing the roots of a tree close to its trunk and then sealing the soil surface with asphalt or concrete up to the trunk
- Open trenching alongside a street tree severing all roots in the trench, then top lopping it for power line clearance, and then extensive damage to bark by abrasion by trucks and excavation equipment as tree is adjacent to a construction site
- Root damage from *soil compaction* to substantial areas of the root plate.

Prolonged Senescence A phenomenon in an *over-mature* tree or tree with *structural deterioration* in its *condition* and often *vigour* as *abnormal vigour* as a result of modifications to the tree or the growing environment essential for its survival where it is sustained beyond the *typical* extent of its life cycle, or prevented from failing in full or part from *structural deterioration* by a beneficial artificial modification to its growing environment either by deliberate or incidental intervention, e.g. water from a leaking tap, water and nutrients from a leaking sewer pipe creating a *hydroponic* environment, or by physically propping up a tree with *structural deterioration* as with a *veteran tree*, or by it *leaning* or growing against another tree or structure for support.

Visual Tree Assessment (VTA) A visual inspection of a tree from the ground based on the principle that, when a tree exhibits apparently superfluous material in its shape, this represents repair structures to rectify *defects* or to reinforce weak areas subject to additional loading forces of compression, tension, torsion and shear. Such assessments should only be undertaken by suitably competent practitioners.

Drop Zone The distance away from a tree that may be physically influenced by a falling branch.

Fall Zone The distance away from a tree that may be physically influenced if it was cut down or subject to *collapse*.

Leaning Trees

Leaning A tree where the *trunk* grows or moves away from upright. A lean may occur anywhere along the *trunk* influenced by a number of contributing factors e.g. genetically predetermined characteristics, competition for space or light, prevailing winds, aspect, slope, or other factors. A *leaning* tree may maintain a *static lean* or display an increasingly *progressive lean* over time and may be hazardous and prone to *failure* and *collapse*. The degrees of leaning can be categorized as *Slightly Leaning*, *Moderately Leaning*, *Severely Leaning* and *Critically Leaning*.

Slightly Leaning A leaning tree where the trunk is growing at an angle within 0°-15° from upright.

Moderately Leaning A leaning tree where the trunk is growing at an angle within 15°-30° from upright.

Severely Leaning A leaning tree where the trunk is growing at an angle within 30°-45° from upright.

Critically Leaning A leaning tree where the trunk is growing at an angle greater than $>45^{O}$ from upright.

Progressively Leaning A tree where the degree of *leaning* appears to be increasing over time.

Static Leaning A leaning tree whose lean appears to have stabilized over time.

Windthrow Tree failure and collapse when a *force* exerted by wind against the *crown* and *trunk* overcomes resistance to that force in the *root plate*, such that the *root plate* is lifted from the soil on one side as the tree tips over.

Symmetry

Symmetry Balance within a *crown,* or *root plate,* above or below the *axis* of the trunk of branch and foliage, and root distribution respectively and can be categorized as *Asymmetrical* and *Symmetrical*.

Asymmetrical Imbalance within a crown, where there is an uneven distribution of branches and the foliage *crown* or *root plate* around the vertical *axis* of the trunk. This may be due to *Crown Form Codominant* or *Crown From Suppressed* as a result of natural restrictions e.g. from buildings, or from competition for space and light with other trees, or from exposure to wind, or artificially caused by pruning for clearance of roads, buildings or power lines. An example of an expression of this may be, crown asymmetrical, bias to west. See also *Symmetrical* and *Symmetry*.

Symmetrical Balance within a crown, where there is an even distribution of branches and the *foliage crown* around the vertical *axis* of the trunk. This usually applies to trees of *Crown Form Dominant* or *Crown Form Forest*. An example of an expression of this may be crown symmetrical. See also *Symmetry* and *Asymmetrical*.

Crown Spread Orientation Direction of the *axis* of *crown spread* which can be categorized as *Orientation Radial* and *Orientation Non-radial*.

Crown Spread Orientation Non-radial Where the crown extent is longer than it is wide, e.g. east/west or E/W. Further examples, north/south or N/S, and may be *Crown Form Codominant*, e.g. **A** or **B**, *Crown Form Intermediate* e.g. **A**, or *Crown Form Suppressed* e.g. **B***, and* crown symmetry is *symmetrical* e.g. **A**, or *asymmetrical* e.g. **B**.

Crown Spread Orientation Radial Where the *crown spread* is generally an even distance in all directions from the trunk and often where a tree has *Crown Form Dominant* and is *symmetrical.*

Diameter at Breast Height (DBH) Measurement of trunk width calculated at a given distance above ground from the base of the tree often measured at 1.4 m. The trunk of a tree is usually not a circle when viewed in cross section, due to the presence of *reaction wood* or *adaptive wood*, therefore an average diameter is determined with a *diameter tape* or by recording the trunk along its narrowest and widest axes, adding the two dimensions together and dividing them by 2 to record an average and allowing the orientation of the longest axis of the trunk to also be recorded. Where a tree is growing on a lean the distance along the top of the trunk is measured to 1.4m and the diameter then recorded from that point perpendicular to the edge of the trunk. Where a *leaning* trunk is *crooked* a vertical distance of 1.4m is measured from the ground. Where a tree branches from a trunk that is less than 1.4m above ground, the trunk diameter is recorded perpendicular to the length of the *trunk* from the point immediately below the base of the flange of the *branch collar* extending the furthest down the trunk, and the distance of this point above ground recorded as *trunk* length. Where a tree is located on sloping ground the DBH should be measured at half way along the side of the tree to average out the angle of slope. Where a tree is *acaulescent* or *trunkless* branching at or near ground an average diameter is determined by recording the radial extent of the trunk at or near ground and noting where the measurement was recorded e.g. at ground.

Significant Important, weighty or more than ordinary.

Significant Tree A tree considered important, weighty or more than ordinary. Example: due to prominence of location, or *in situ*, or contribution as a component of the overall landscape for *amenity* or aesthetic qualities, or *curtilage* to structures, or importance due to uniqueness of taxa for species, subspecies, variety, *crown form*, or as an historical or cultural planting, or for age, or substantial dimensions, or habit, or as *remnant vegetation*, or habitat potential, or a rare or threatened species, or uncommon in cultivation, or of aboriginal cultural importance, or is a commemorative planting.

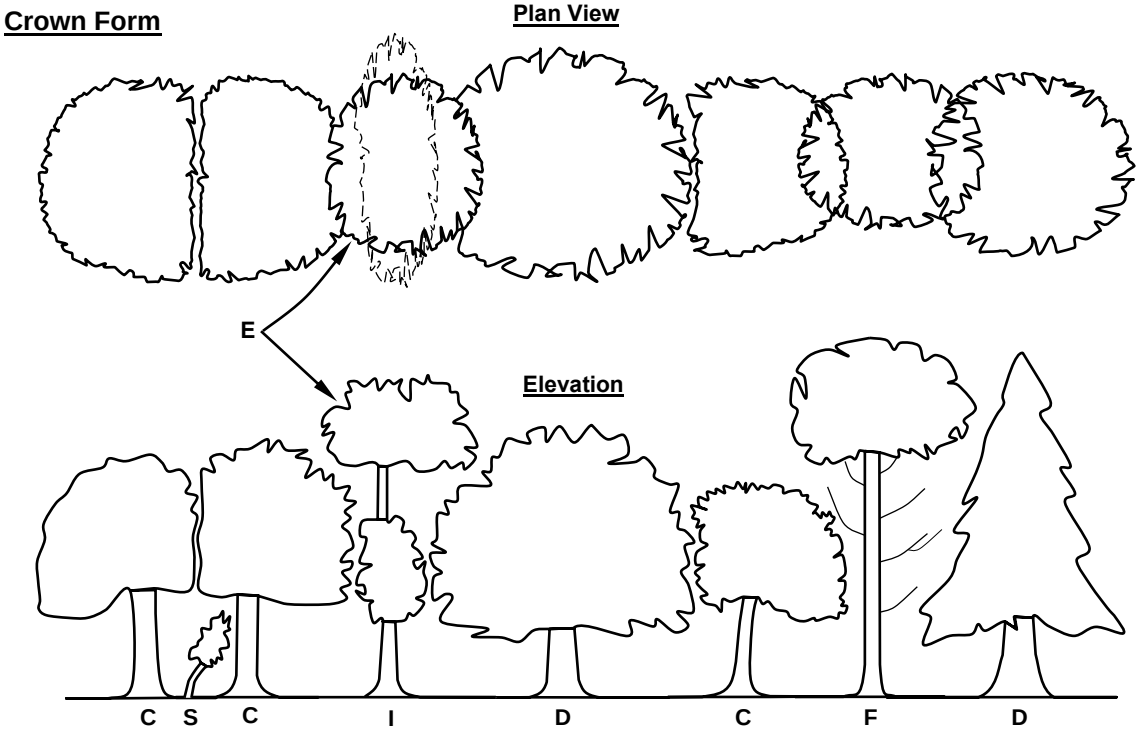
Sustainable Retention Index Value (SRIV) A visual tree assessment method to determine a qualitative and numerical rating for the viability of urban trees for development sites and management purposes, based on general tree and landscape assessment criteria using classes of *age*, *condition* and *vigour*. SRIV is for the professional manager of urban trees to consider the tree *in situ* with an assumed knowledge of the *taxon* and its growing environment. It is based on the physical attributes of the tree and its response to its environment considering its position in a matrix for age class, vigour class, condition class and its sustainable retention with regard to the safety of people or damage to property. This also factors the ability to retain the tree with remedial work or beneficial modifications to its growing environment or removal and replacement. SRIV is supplementary to the decision made by a tree management professional as to whether a tree is retained or removed (IACA - Institute of Australian Consulting Arboriculturists 2005).

Form of Trees

Crown Form The shape of the crown of a tree as influenced by the availability or restriction of space and light, or other contributing factors within its growing environment. Crown Form may be determined for tree shape and habit generally as *Dominant*, *Codominant*, *Intermediate*, *Emergent*, *Forest* and *Suppressed*. The habit and shape of a *crown* may also be considered qualitatively and can be categorized as *Good Form* or *Poor Form*. See also *Forest Grown* and *Open Grown*.

Good Form Tree of *typical* crown shape and habit with proportions representative of the taxa considering constraints such as origin e.g. indigenous or exotic, but does not appear to have been adversely influenced in its development by environmental factors in situ such as *soil water* availability, prevailing wind, or cultural practices such as lopping and competition for space and light. See also *Poor Form*.

Poor Form Tree of *atypical* crown shape and habit with proportions not representative of the species considering constraints and appears to have been adversely influenced in its development by environmental factors in situ such as *soil water* availability, prevailing wind, cultural practices such as lopping and competition for space and light; causing it to be *misshapen* or disfigured by disease or vandalism. See also *Good Form*.



(Source: **D**, **C**, **I** and **S**, and Elevation, Matheny and Clark 1998, **E**, **F** and Plan View, IACA 2005)

D. Dominant, **F.** Forest, **C.** Codominant, **E.** Emergent, **I.** Intermediate, **S.** Suppressed

Crown Form Codominant Crowns of trees restricted for space and light on one or more sides and receiving light primarily from above e.g. constrained by another tree/s or a building.

Crown Form Dominant Crowns of trees generally not restricted for space and light receiving light from above and all sides. See also *Crown Form Emergent* and *Open Grown*.

Crown Form Emergent Crowns of trees restricted for space on most sides receiving most light from above until the *upper crown* grows to protrude above the canopy in a stand or forest environment. Such trees may be *crown form dominant* or transitional from *crown form intermediate* to *crown form forest* asserting both *apical dominance* and *axillary dominance* once free of constraints for space and light.

Crown Form Forest Crowns of trees restricted for space and light except from above forming tall trees with narrow spreading crowns with foliage restricted generally to the top of the tree. The trunk is usually erect, straight and continuous, tapering gradually, crown often excurrent, with first order branches becoming structural, supporting the live crown concentrated towards the top of the tree, and below this point other first order branches arising radially with each *inferior* and usually temporary, divergent and ranging from horizontal to ascending, often with internodes exaggerated due to competition for space and light in the *lower crown*.

Crown Form Intermediate Crowns of trees restricted for space on most sides with light primarily from above and on some sides only.

Crown Form Suppressed Crowns of trees generally not restricted for space but restricted for light by being *overtopped* by other trees and occupying an understorey position in the canopy and growing slowly.

Forest Grown A tree with *crown form forest* grown in a group with competition for space and light protected from wind, often resulting in a taller tree with a narrow spreading crown that is concentrated towards the top of the tree (Matheny & Clark 1998, p. 18).

Open Grown A tree with *crown form dominant*, grown singly without competition for space and light, exposed to wind, often resulting in a shorter tree with a broad spreading crown that extends towards the ground (Matheny & Clark 1998, p. 18).

Deadwood

Deadwood Dead branches within a tree's crown and considered quantitatively as separate to *crown cover* and can be categorised as *Small Deadwood* and *Large Deadwood* according to diameter, length and subsequent *risk* potential. The amount of dead branches on a tree can be categorized as *Low Volume Deadwood*, *Medium Volume Deadwood* and *High Volume Deadwood*. See also *Dieback.*

Deadwooding Removing of dead branches by *pruning*. Such pruning may assist in the prevention of the spread of *decay* from *dieback* or for reasons of safety near an identifiable target.

Small Deadwood A dead branch up to 10mm diameter and usually <2 metres long, generally considered of low *risk* potential.

Large Deadwood A dead branch >10mm diameter and usually >2 metres long, generally considered of high *risk* potential.

Low Volume Deadwood Where <5 dead branches occur that may require *removal*.

Medium Volume Deadwood Where 5-10 dead branches occur that may require *removal*.

High Volume Deadwood High Volume Deadwood Where >10 dead branches occur that may require *removal*.

Dieback

Dieback The death of some areas of the *crown*. Symptoms are leaf drop, bare twigs, dead branches and tree death, respectively. This can be caused by root damage, root disease, bacterial or fungal canker, severe bark damage, intensive grazing by insects, *abrupt changes* in growth conditions, drought, water-logging or over-maturity. Dieback often implies reduced *resistance, stress* or *decline* which may be temporary. Dieback can be categorized as *Low Volume Dieback*, *Medium Volume Dieback* and *High Volume Dieback*.

Low Volume Dieback Where <10% of the *crown cover* has died. See also *Dieback*, *High Volume Dieback* and *Medium Volume Dieback*.

Medium Volume Dieback Where 10-50% of the *crown cover* has died.

High Volume Dieback Where >50% of the *crown cover* has died.

Epicormic Shoots

Epicormic Shoots Juvenile shoots produced at branches or trunk from *epicormic strands* in some Eucalypts (Burrows 2002, pp. 111-131) or sprouts produced from dormant or latent buds concealed beneath the bark in some trees. Production can be triggered by fire, pruning, wounding, or root damage but may also be as a result of *stress* or *decline*. Epicormic shoots can be categorized as *Low Volume Epicormic Shoots*, *Medium Volume Epicormic Shoots* and *High Volume Epicormic Shoots*.

Low Volume Epicormic Shoots Where <10% of the c*rown cover* is comprised of live *epicormic shoots*.

Medium Volume Epicormic Shoots Where 10-50% of the *crown cover* is comprised of live *epicormic shoots*.

High Volume Epicormic Shoots Where >50% of the *crown cover* is comprised of live *epicormic shoots*.

Epicormic Strands In some taxa of the Myrtaceae family narrow bands of meristematic tissue radiate in stems from pith extending to the outer bark containing bud primordia evident as small prickle or dimple structures up to 10 mm diameter, that after the stimulus of a trauma event such as fire or defoliation develop to form new buds allowing *crown regeneration* (Burrows 2001, Pp. 111-131).

Trunk

Acaulescent A *trunkless* tree or tree growth forming a very short *trunk*. See also *Caulescent.*

Caulescent Tree grows to form a *trunk*. See also *Acaulescent*.

Trunk A single stem extending from the *root crown* to support or elevate the *crown*, terminating where it divides into separate *stems* forming *first order branches*. A trunk may be evident at or near ground or be absent in *acaulescent* trees of *deliquescent* habit, or may be continuous in trees of *excurrent* habit. The trunk of any *caulescent* tree can be divided vertically into three (3) sections and can be categorized as *Lower Trunk*, *Mid Trunk* and *Upper Trunk*. For a *leaning* tree these may be divided evenly into sections of one third along the trunk.

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Our Ref: DJW: L.T2021.003.docx

3 April 2020
Providence Asset Group
c/o KDC
Suite 2B, 125 Bull Street
Newcastle West NSW 2302
Attention: Rosie Turner

Dear Rosie

RE: FLOOD IMPACT ASSESSMENT FOR PROPOSED SOUTH TAMWORTH SOLAR FARM, NSW

Background

Torrent Consulting was engaged to undertake a Flood Impact Assessment to assist in the DA process for the proposed South Tamworth Solar Farm at Country Road (Part Lot 211 DP1069964), Westdale, NSW (the Site). It is understood that flood risk is expected to require assessment as part of the DA, although no current information exists for the Site.

The Site is located on the western slopes of the Timbumburi Creek catchment, as presented in Figure 1. Being elevated some 30 m above Timbumburi Creek, the Site is not expected to be flood-affected from this watercourse. However, a small mapped watercourse traverses the Site, conveying local catchment runoff to Timbumburi Creek from the hill slopes to the west. This local catchment drainage only constitutes some 15 ha in area and as such is not expected to present any significant flood risk to the Site.

There are no existing design flood conditions at the Site. The assessment therefore includes the development of a TUFLOW model of local catchments at the Site. This model will provide a platform to assess the potential flood impacts associated with the proposed development. It will also enable a more detailed understanding of the local flood depths, velocities and hazards.

Model Development

For this assessment a TUFLOW hydraulic model was developed covering the hillslope on which the Site is located, for which the contributing catchment area is around 15 ha. The model utilised the NSW Spatial Services LiDAR data product, downloaded via the ELVIS Foundation Spatial Data portal to define the local topography, as presented in Figure 2.

As the Site is located near the top of a hill the TUFLOW model was developed covering the area 300 m beyond the Site in all directions, as presented in Figure 3. The model was constructed using a 2 m grid cell resolution, sampling elevations from the LiDAR data.

Land use coverage in the catchment was digitised using aerial imagery, to distinguish between cleared land and areas of remnant vegetation. The cleared land was assigned a Manning's 'n' roughness coefficient of 0.05, with areas of remnant vegetation being assigned an 'n' value of 0.1.

The downstream boundary of the model was configured as an automatically generated stage-discharge curve with a slope of 3%. Direct rainfall input was applied to the full modelled area to simulate catchment runoff and any resultant flooding.

Design Flood Hydrology

The TUFLOW model was simulated (using the HPC solver) for the 5% AEP and 1% AEP design rainfall events for storm durations ranging from ten minutes to 30 minutes. The design rainfall depths were sourced from the BoM IFD (Intensity Frequency Duration) portal. An Areal Reduction Factor (ARF) was not applied to the design point rainfall as the contributing catchment areas upstream of the Site are negligible. Design rainfall losses considered the recent NSW-specific guidance and initial losses of 3 mm and 7 mm (for the 1% AEP and 5% AEP respectively) and a continuing loss of 0.6 mm/h were adopted accordingly.

The ARR 2019 guidelines ensemble method to design flood hydrology involves the simulation of ten rainfall temporal patterns for each design event magnitude and duration, with the average condition of the ten being adopted for design purposes. The point rainfall temporal patterns provided for the Central Slopes temporal rainfall region were adopted for the ensemble method accordingly.

The TUFLOW model simulations were analysed at the largest point of discharge from the Site (located at the north-east corner) to identify the critical duration, i.e. that which produces the peak flood flows for each design event magnitude. This is undertaken by calculating the average peak flood flow and the peak flood flow variance of the ten simulated hydrographs for each design event duration and magnitude. The 20-minute duration was identified as being critical for the 5% AEP event and the 15-minute duration for the 1% AEP event. The design temporal pattern IDs 2076 and 2032 were selected for the 5% AEP and 1% AEP events respectively, as producing hydrographs most representative of the mean design condition from the results of the ensemble method.

For the simulation of the PMF (Probable Maximum Flood) condition the Generalised Short Duration Method (GSDM) published by the BoM was adopted. Events for the 15-minute to 1-hour durations were simulated to determine the critical conditions. This found the Probable Maximum Precipitation (PMP) for the 15-minute duration to be critical, with a rainfall depth of 190 mm (760 mm/h intensity). The simulated peak design flows discharging from the Site are summarised in Table 1.

Table 1 – Modelled Peak Design Flows (m^3/s)

Design Event	Site Outlet
5% AEP 20-minute (2076)	1.4
1% AEP 15-minute (2032)	2.4
PMF 15-minute (GSDM)	17.8

Note: contents of parentheses denote the adopted design temporal pattern ID

Baseline Design Flood Conditions

The TUFLOW hydraulic model was simulated (using the HPC solver) for the adopted design flood hydrology. Figure 4 presents the modelled peak flood extents at the Site for the 5% AEP, 1% AEP and PMF events. Figure 5, Figure 6 and Figure 7 are presented for additional context and show the modelled peak flood depths and peak flood level contours for the 5% AEP, 1% AEP and PMF events respectively. The results have a 0.1 m minimum depth filter applied to remove the simulated sheet flow from the rainfall-runoff process and only present the accumulated flood flow paths.

Figure 8, Figure 9 and Figure 10 present the flood hazard classification at the Site for the 5% AEP, 1% AEP and PMF events respectively. The flood hazards have been determined in accordance with Guideline 7-3

of the Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR, 2017). This produces a six-tier hazard classification, based on modelled flood depths, velocities and velocity-depth product. The hazard classes relate directly to the potential risk posed to people, vehicles and buildings, as presented in Chart 1.

The flood hazard mapping is useful for providing context to the nature of the modelled flood risk and to identify potential constraints for development of the Site with regards to floodplain risk management. The principal consideration of good practice floodplain risk management is to ensure compatibility of the proposed development with the flood hazard of the land, including the risk to life and risk to property.

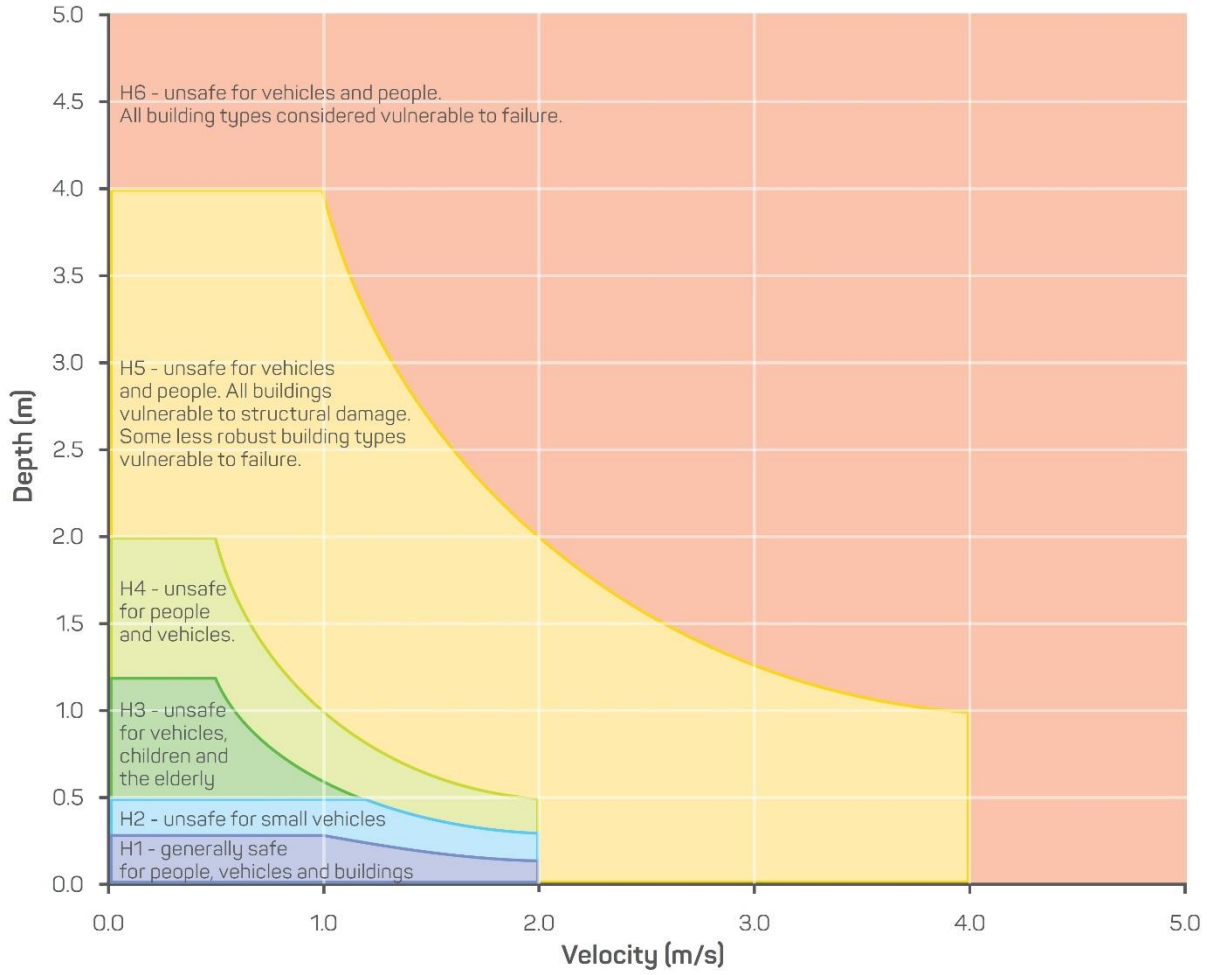


Chart 1 – General Flood Hazard Vulnerability Curves (AIDR, 2017)

The modelled flood conditions show that the Site is largely unaffected by flooding for the range of modelled design flood events. There is a minor flow path being generated in the north-east corner, otherwise modelled depths exceeding 0.1 m are limited to the existing field drainage infrastructure and within the quarry to the south.

At the 1% AEP event (and even at the PMF) the area of the Site proposed for the development of the solar farm is essentially a low hazard (H1 and H2) flood environment with some small localised medium hazard (H3 and H4) flood conditions. As such there is effectively a negligible risk presented to the integrity of the proposed solar farm with regards to potential flood damages.

Flood Impact Assessment

The principal consideration of good practice floodplain risk management is to ensure compatibility of the proposed development with the flood hazard of the land, including the risk to life and risk to property. Requirements within a Council's LEP (Local Environment Plan) and DCP (Development Control Plan) typically consider the management of flood risk, with the application of an FPL (Flood Planning Level) being the principal control measure. The standard FPL for residential development in NSW is the 1% AEP flood level plus a 0.5 m freeboard. However, requirements for non-residential development can vary significantly.

The objective of the management of risk to property is to minimise the damages that would be incurred in the event of a flood. This includes potential damage to future building structures and their contents, and critical infrastructure and services. Risk to property is typically managed to the 1% AEP design flood event.

The flood modelling results show that at the 1% AEP event (and even the PMF) the proposed solar farm infrastructure is largely unaffected by flooding, being effectively a low flood hazard environment. The flood depths are shallow, and the PV tracker arrays will be elevated well above the flood levels.

The objective of the management of risk to life is to minimise the likelihood of deaths in the event of a flood and is typically considered for rarer flood events than the 1% AEP, up to the PMF. Ample flood-free refuge is available on-site if people are present during a flood event. Due to the nature of the local topography it is also expected that the roads connecting the Site with Westdale will also be largely unaffected by flooding.

In addition to the management of flood risk exposure of the proposed development, the potential for off-site flood impacts to the existing baseline flood conditions also need to be considered to avoid adverse impacts to neighbouring property and infrastructure. The details contained in the site plan (SOUTH TAMWORTH - PV Plant Layout [110320].dwg) were incorporated into the TUFLOW model to assess the potential flood impacts. Assumptions include:

- regrading of the existing field drainage infrastructure, including dams and bunds
- application of a 50% blockage to flow around the perimeter fencing
- application of a 2% blockage to flow through the PV tracker arrays to account for the piles (PV modules raised above the flood surface).
- raising of the site access road alignment by 0.15 m above ground surface
- raising of the gravel hardstand construction laydown by 0.15 m above ground surface
- raising above the floodplain of all internal site infrastructure other than the PV trackers
- incorporation of proposed stormwater management infrastructure (200335 - CIV01-02 - DA.pdf) including pipes and basin.

The design flood events were then re-simulated, and the results compared to the baseline results to identify potential flood impacts.

The results of the flood impact assessment are presented in Figure 11 and Figure 12 for the modelled peak flood level impacts and in Figure 13 and Figure 14 for the flood velocity impacts. The modelled 1% AEP post-development flood conditions are presented for peak flood depths and levels in Figure 15 and flood hazard classification in Figure 16.

The assessment indicates that the flood impacts of the proposed solar farm development are minor and localised. There is 0.03 m increased flood level modelled within the quarry due to the potential for the Site access road to divert some additional runoff to the south. However, the model representation of the access road is relatively simplified and does not incorporate any local road drainage works that may manage this.

There is also a 0.02 m increased flood level modelled at the point of discharge at the north-east corner of the Site due to the reduced attenuation of Site runoff through removal of the existing field drainage infrastructure. If required, this impact could likely be managed through the construction of a small bund along the northern boundary of the Site.

Conclusion

Torrent Consulting was engaged to undertake a Flood Impact Assessment to assist in the DA process for the proposed South Tamworth Solar Farm.

This assessment has included development of a TUFLOW model for the local catchment runoff and has simulated design flood conditions in accordance with the ARR 2019 guidelines, specifically the ensemble method for design flood hydrology.

Flood hazard mapping has been produced that shows that the Site is of a low flood risk and is suitable for the proposed solar farm.

The flood modelling results show that at the 1% AEP event (and even the PMF) the proposed solar farm infrastructure is largely unaffected by flooding, being effectively a low flood hazard environment. The flood depths are shallow, and the PV tracker arrays will be elevated well above the flood levels.

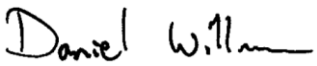
Ample flood-free refuge is available on-site if people are present during a flood event. Due to the nature of the local topography it is also expected that the roads connecting the Site with Westdale will also be largely unaffected by flooding.

The assessment indicates that the flood impacts of the proposed solar farm development are minor and localised. The modelled impacts are not considered to adversely affect neighbouring properties and can be readily managed if required.

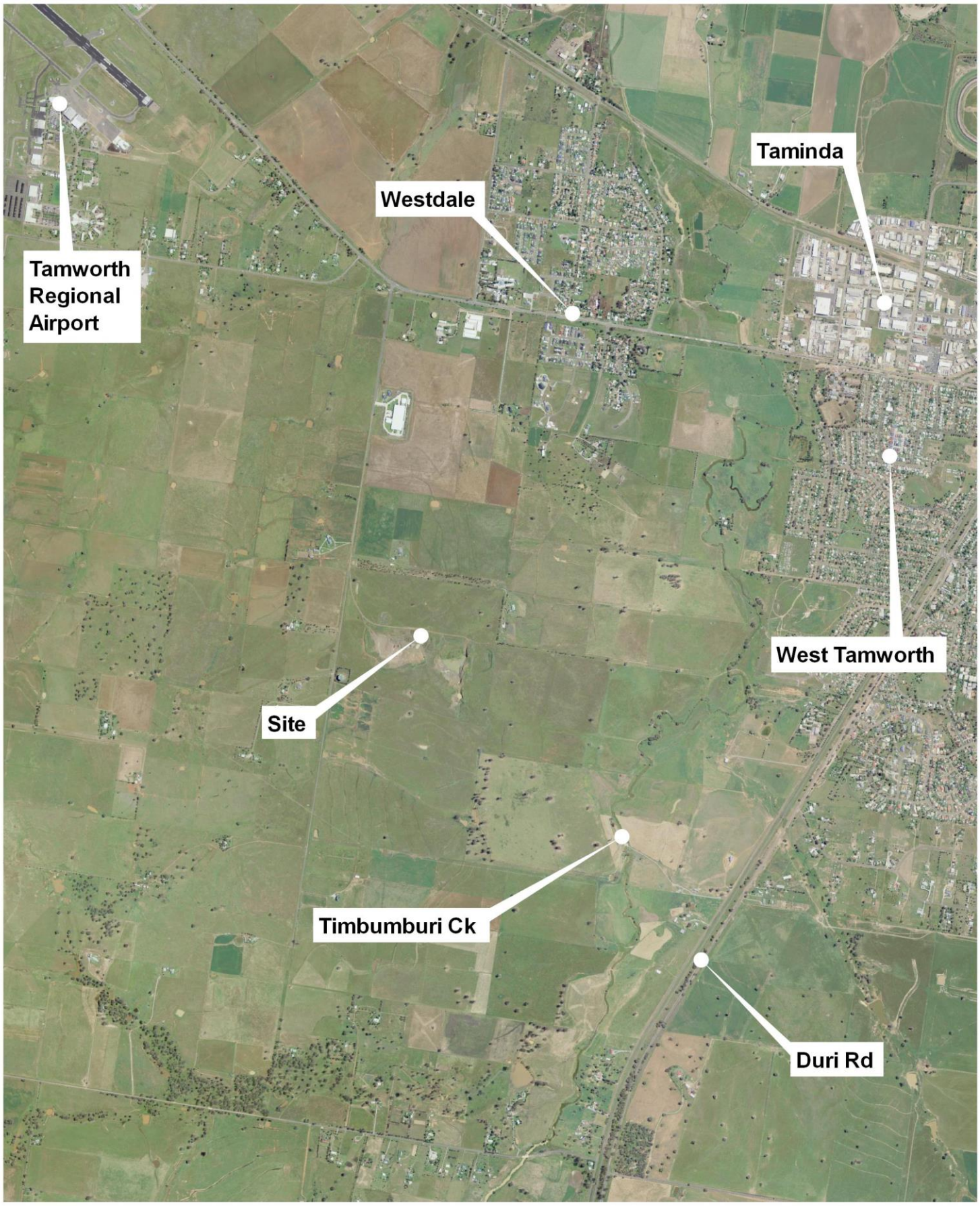
We trust that this report meets your requirements. For further information or clarification please contact the undersigned.

Yours faithfully

Torrent Consulting



Dan Williams
Director



Title:

Study Locality

0 0.7 1.4 km

approx. scale

Figure: 1

Revision: A

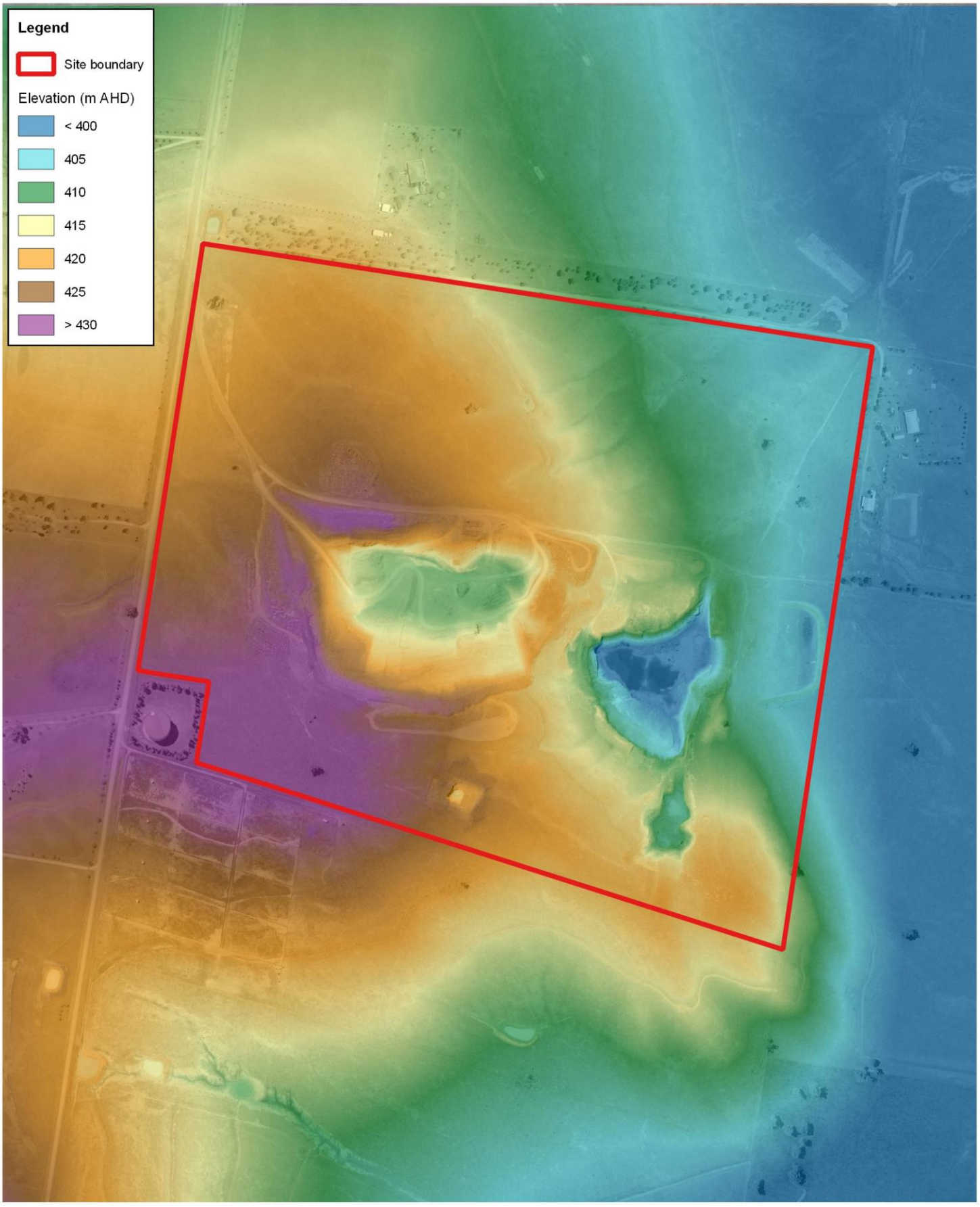
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Filepath: \Projects\T2021_Country_Rd_FIA\GIS\T2021_001_200311_Locality.qgz



Title:

Site Topography

0 100 200 m

approx. scale

Figure: 2

Revision: A

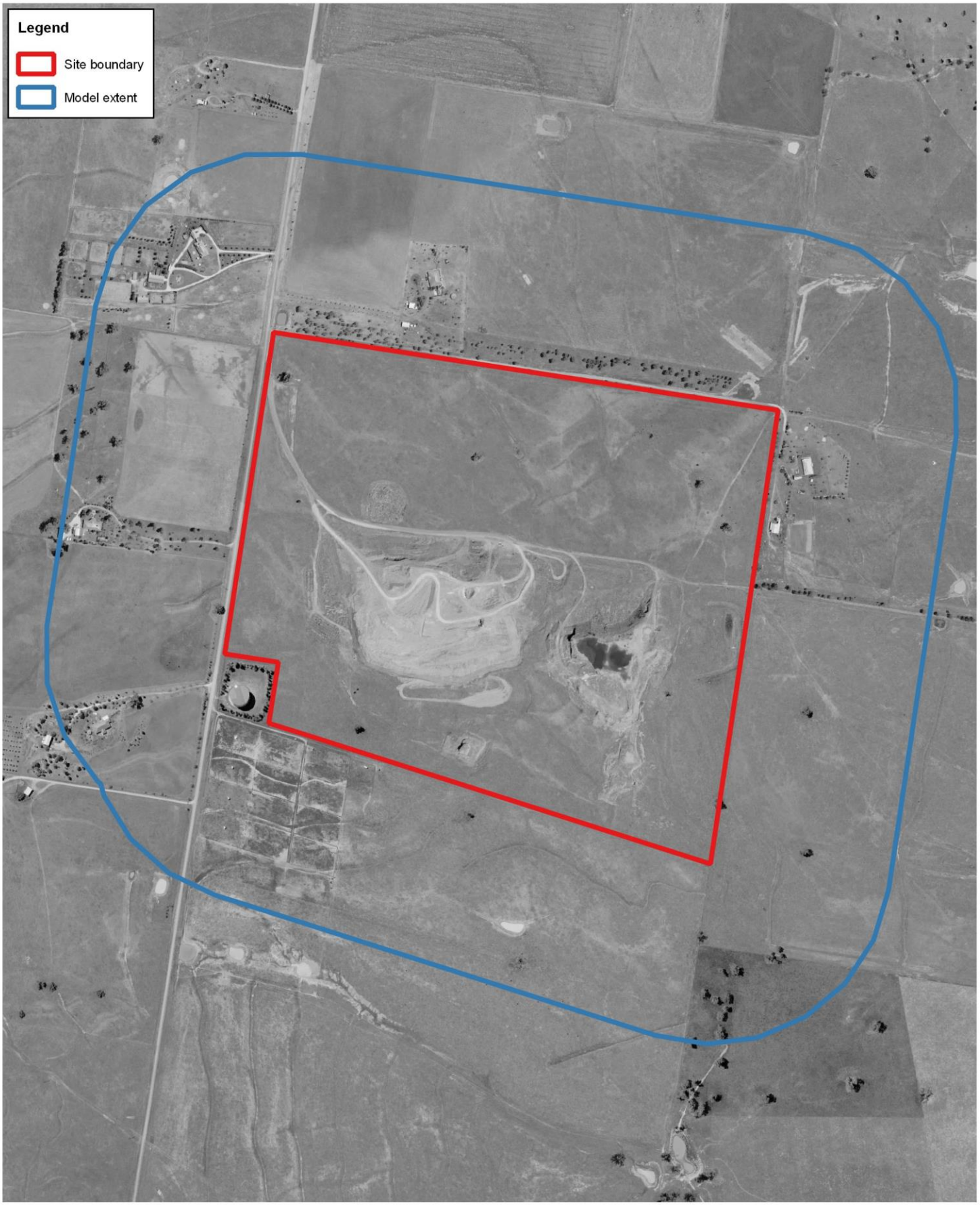
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Title:

TUFLOW Model Components

0 200 400 m

approx. scale

Figure: 3

Revision: A

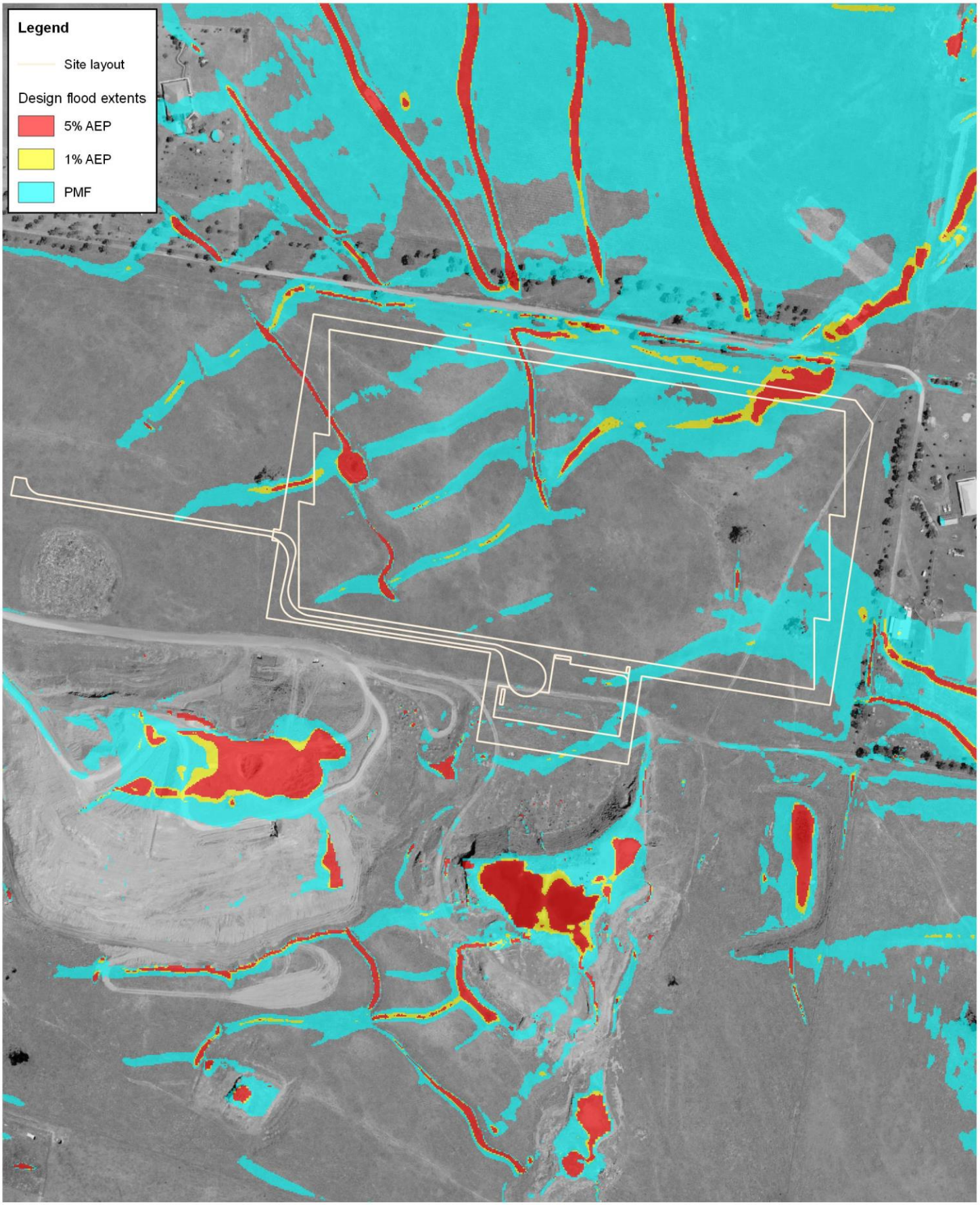
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Title:

Modelled Flood Extents and Site Layout

0 100 200 m

approx. scale

Figure: 4

Revision: A

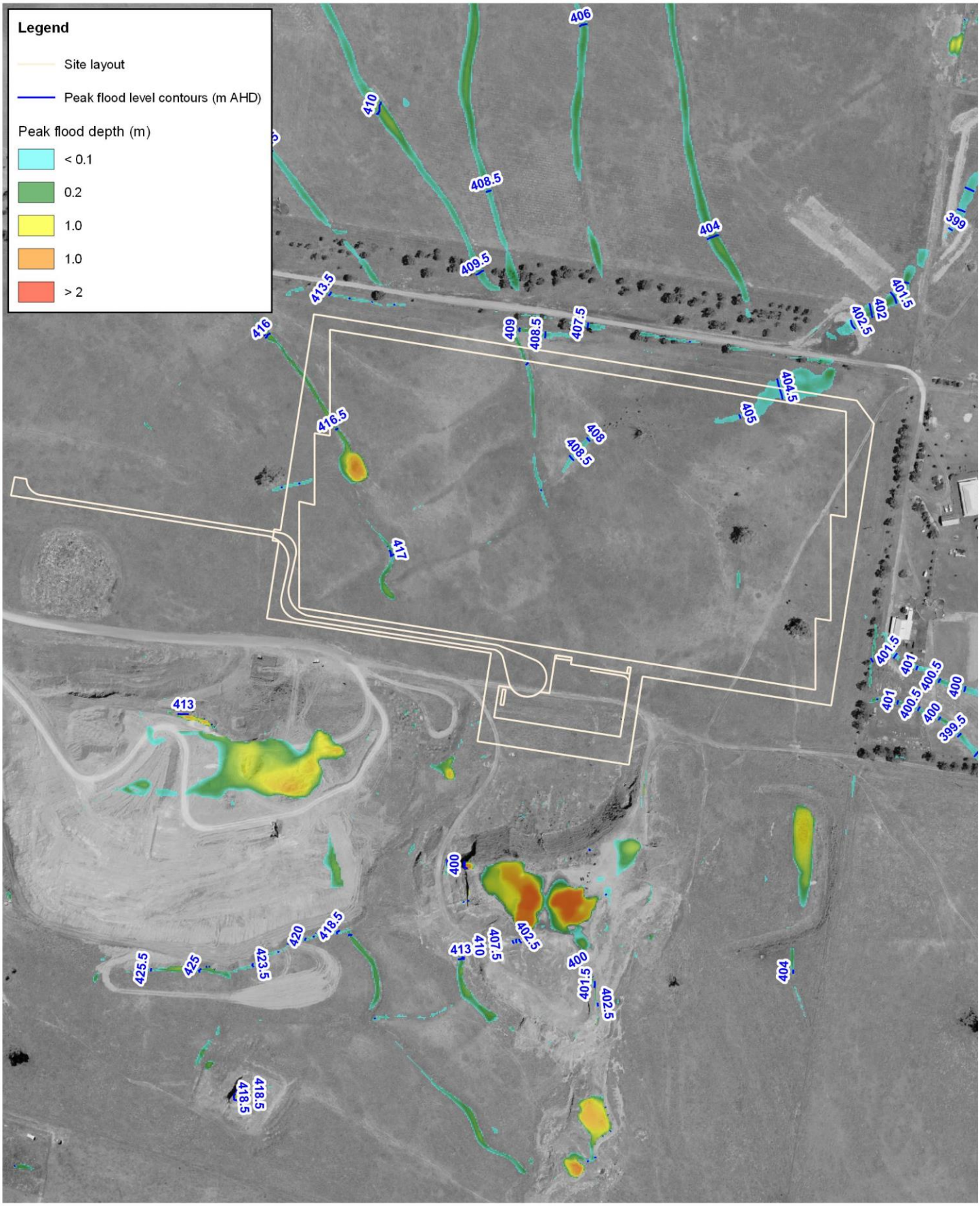
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Title:

Modelled 5% AEP Flood Depths and Levels

0 100 200 m

approx. scale

Figure: 5

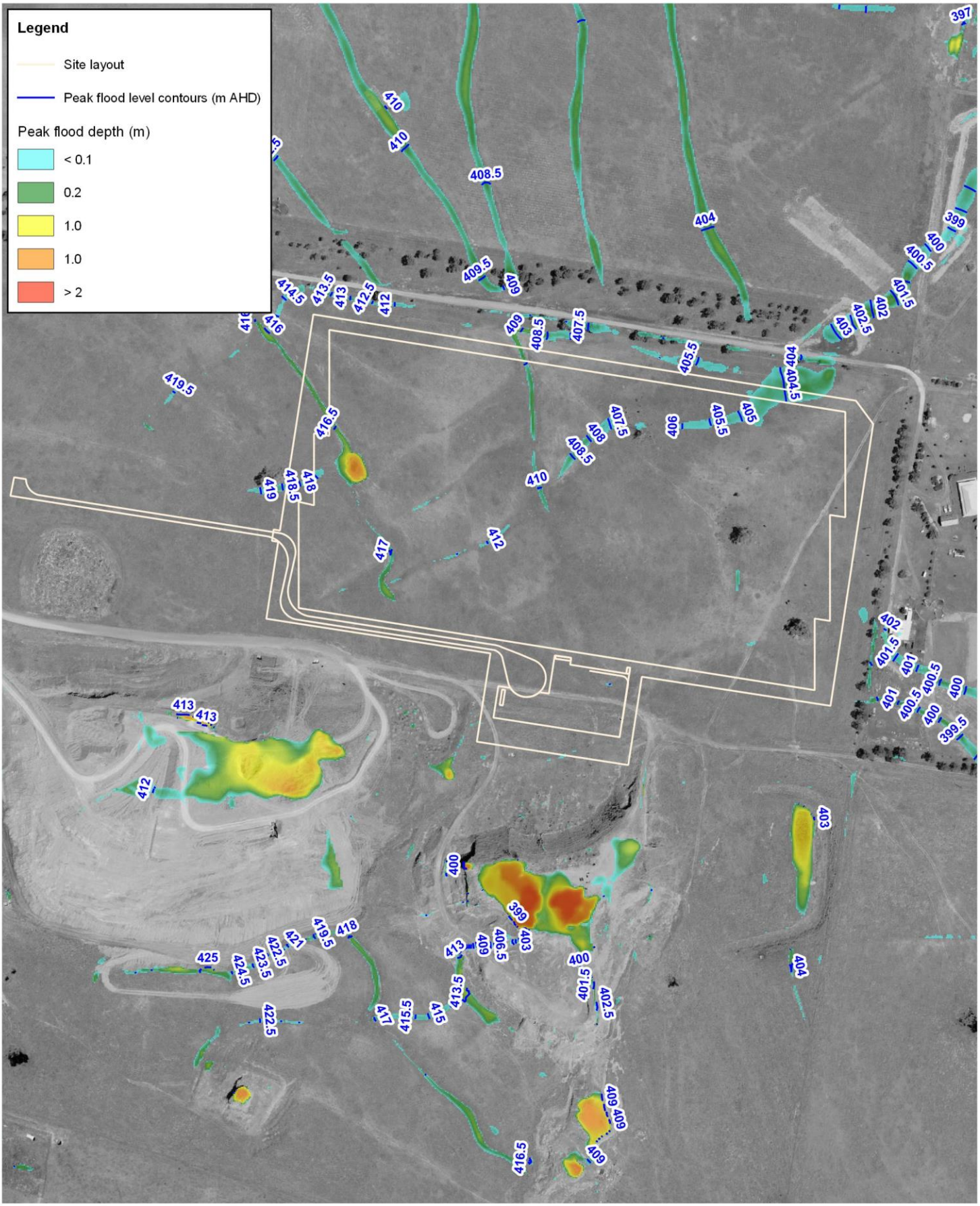
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Title:

Modelled 1% AEP Flood Depths and Levels

0 100 200 m

approx. scale

Figure: 6

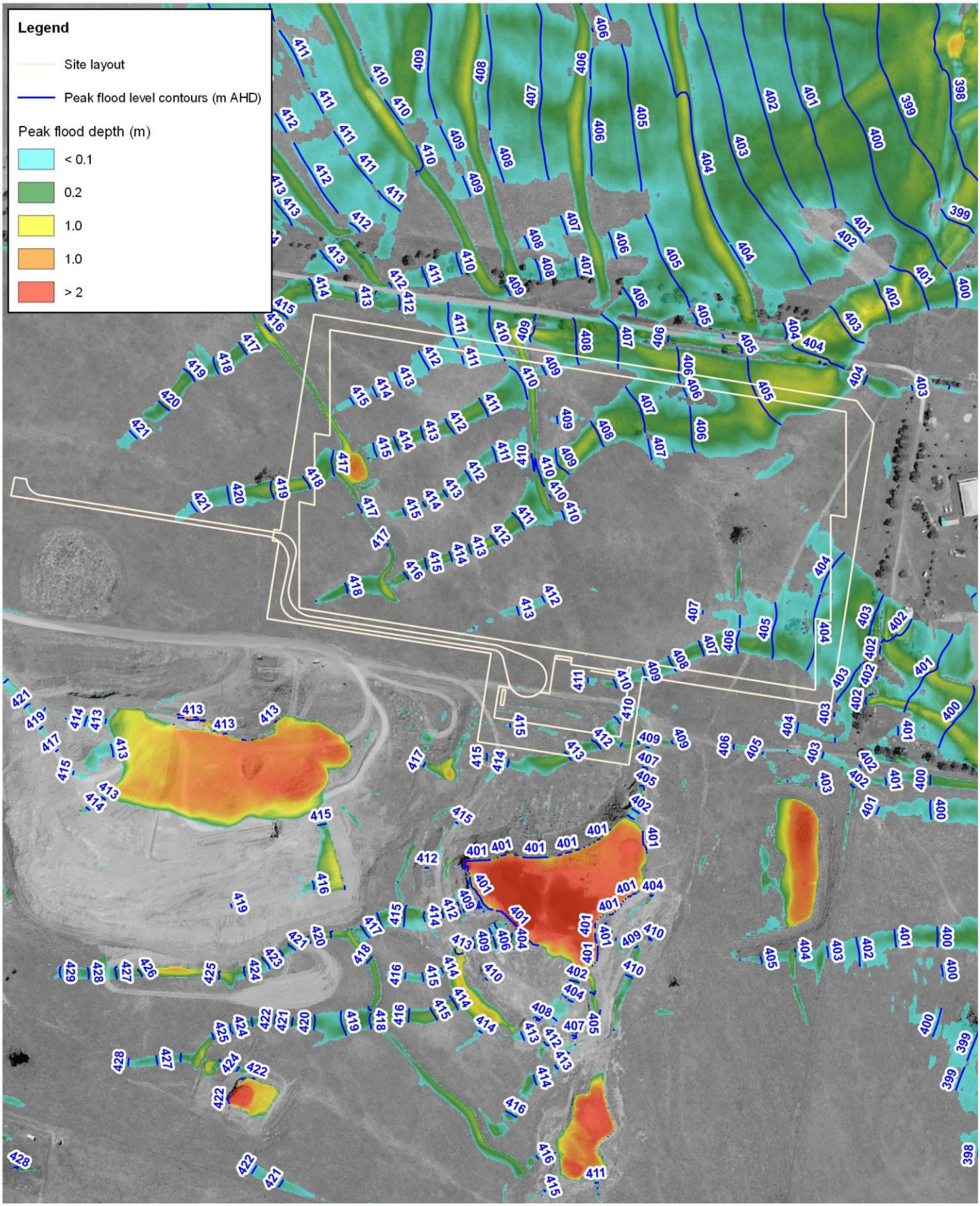
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Title:

Modelled PMF Flood Depths and Levels

0 100 200 m

approx. scale

Figure: 7

Revision: A

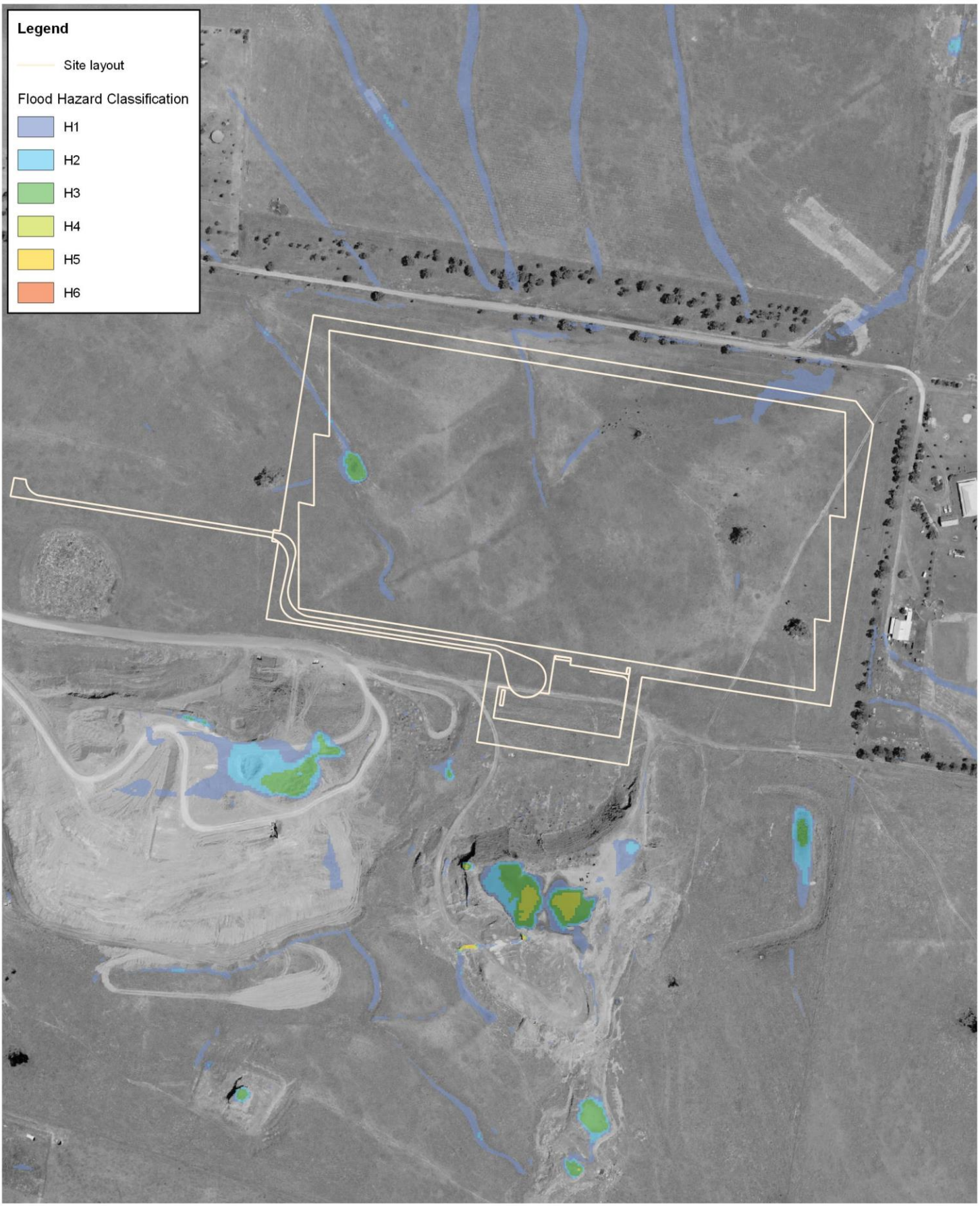
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Title:

Modelled 5% AEP Flood Hazard Classification

0 100 200 m

approx. scale

Figure: 8

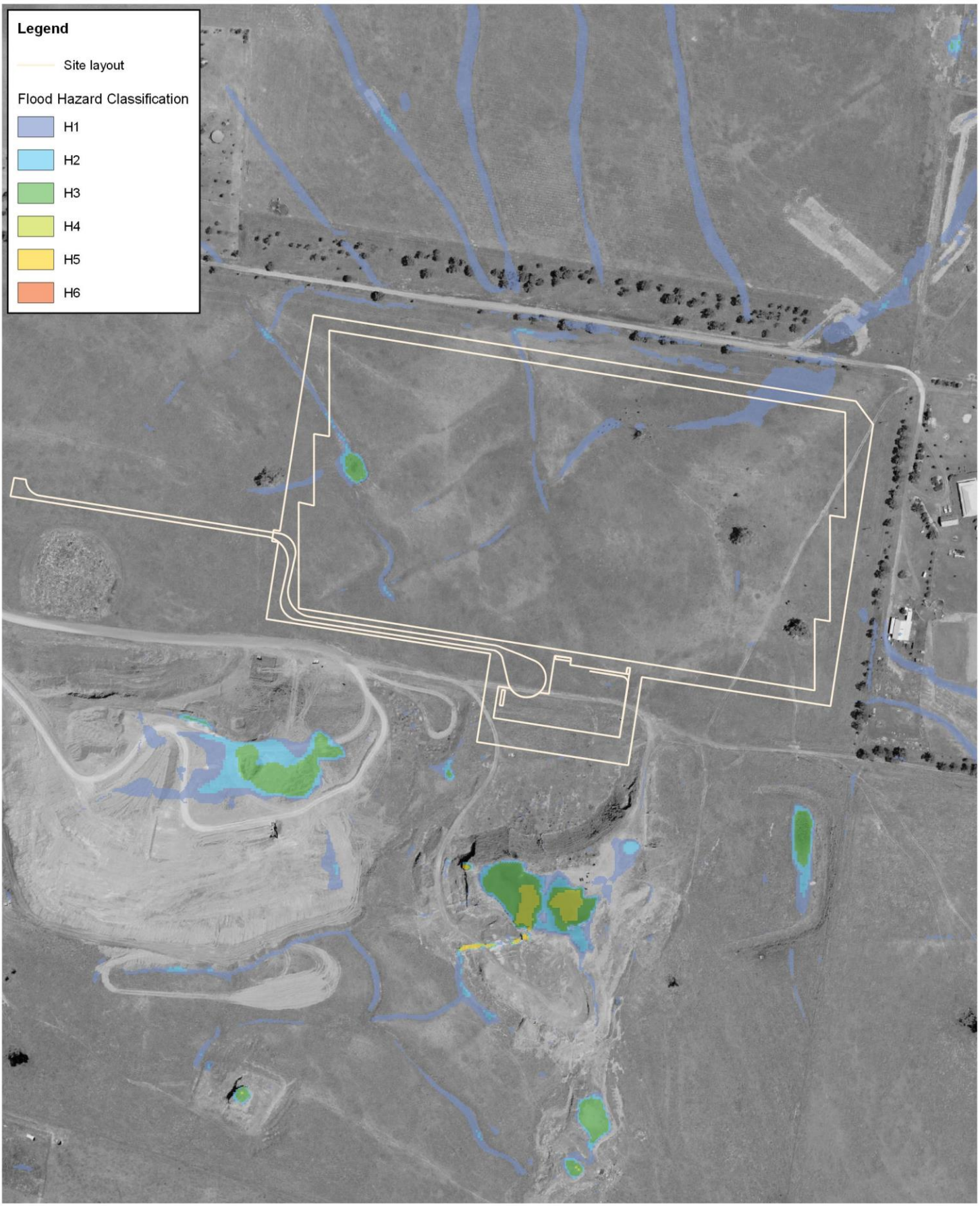
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Title:

Modelled 1% AEP Flood Hazard Classification

0 100 200 m

approx. scale

Figure: 9

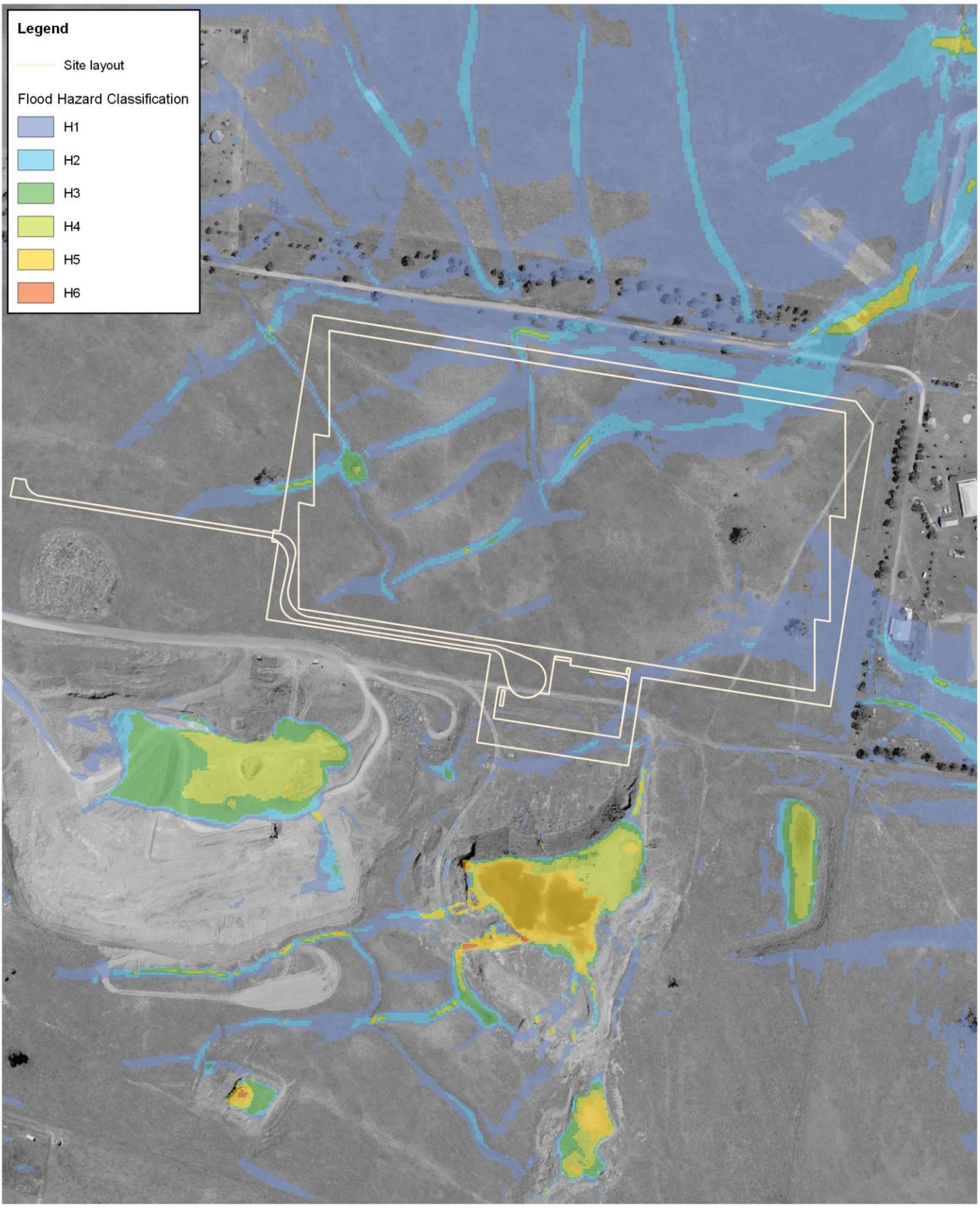
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Title:

Modelled PMF Flood Hazard Classification

0 100 200 m

approx. scale

Figure: 10

Revision: A

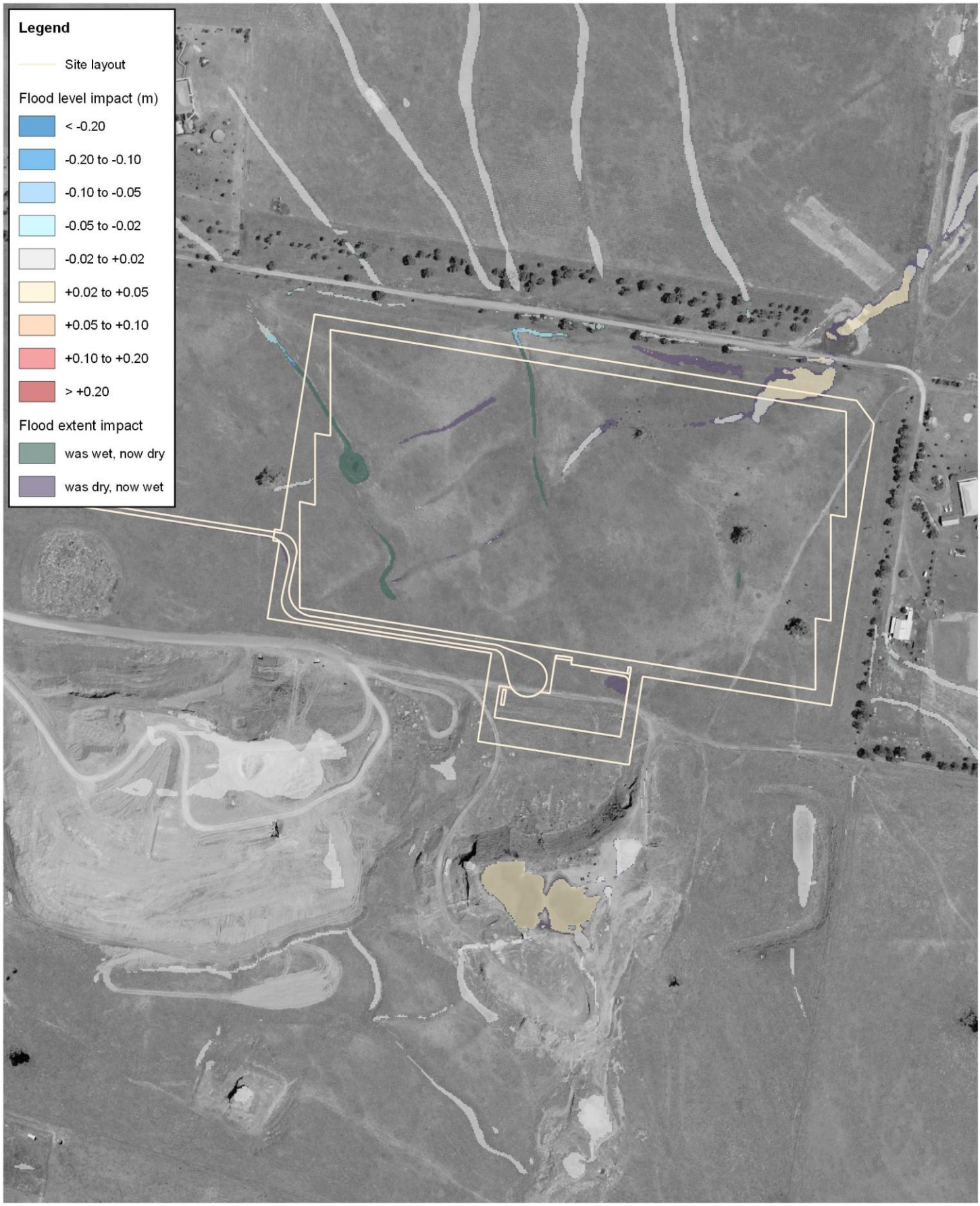
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Title:

Modelled 5% AEP Peak Flood Level Impact

0 100 200 m

approx. scale

Figure: 11

Revision: A

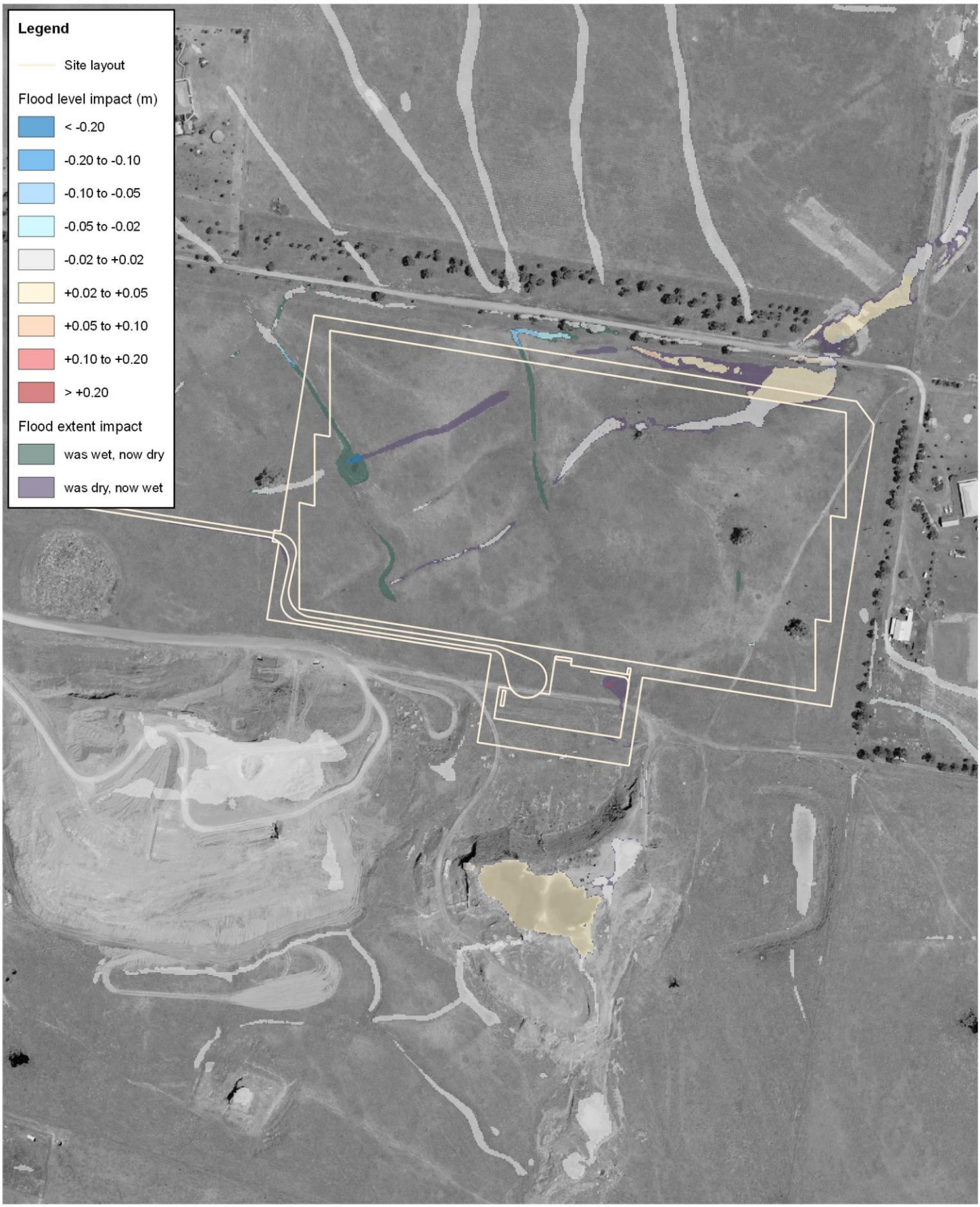
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Title:

Modelled 1% AEP Peak Flood Level Impact

0 100 200 m

approx. scale

Figure: 12

Revision: A

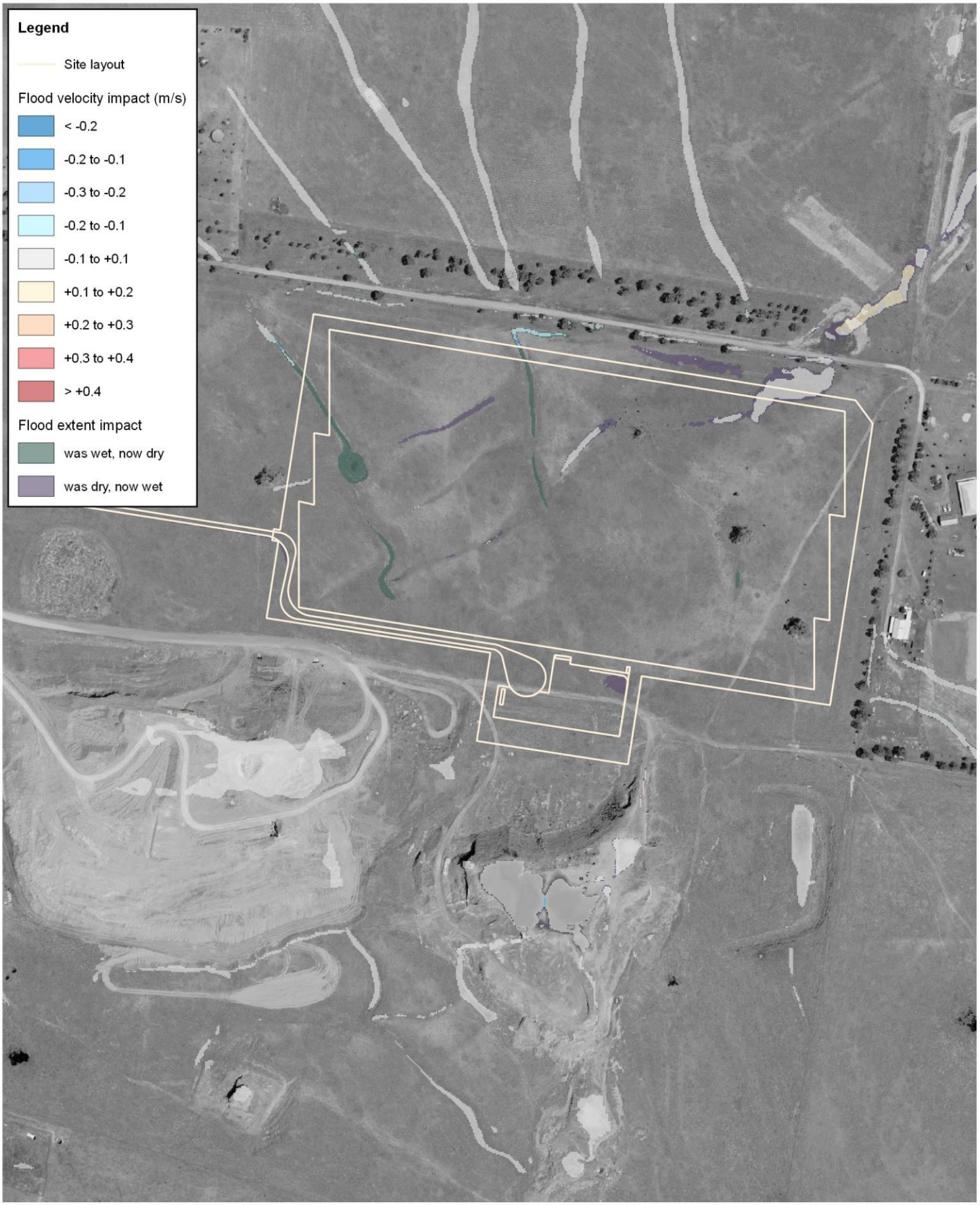
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Title:

Modelled 5% AEP Peak Flood Velocity Impact

0 100 200 m

approx. scale

Figure: 13

Revision: A

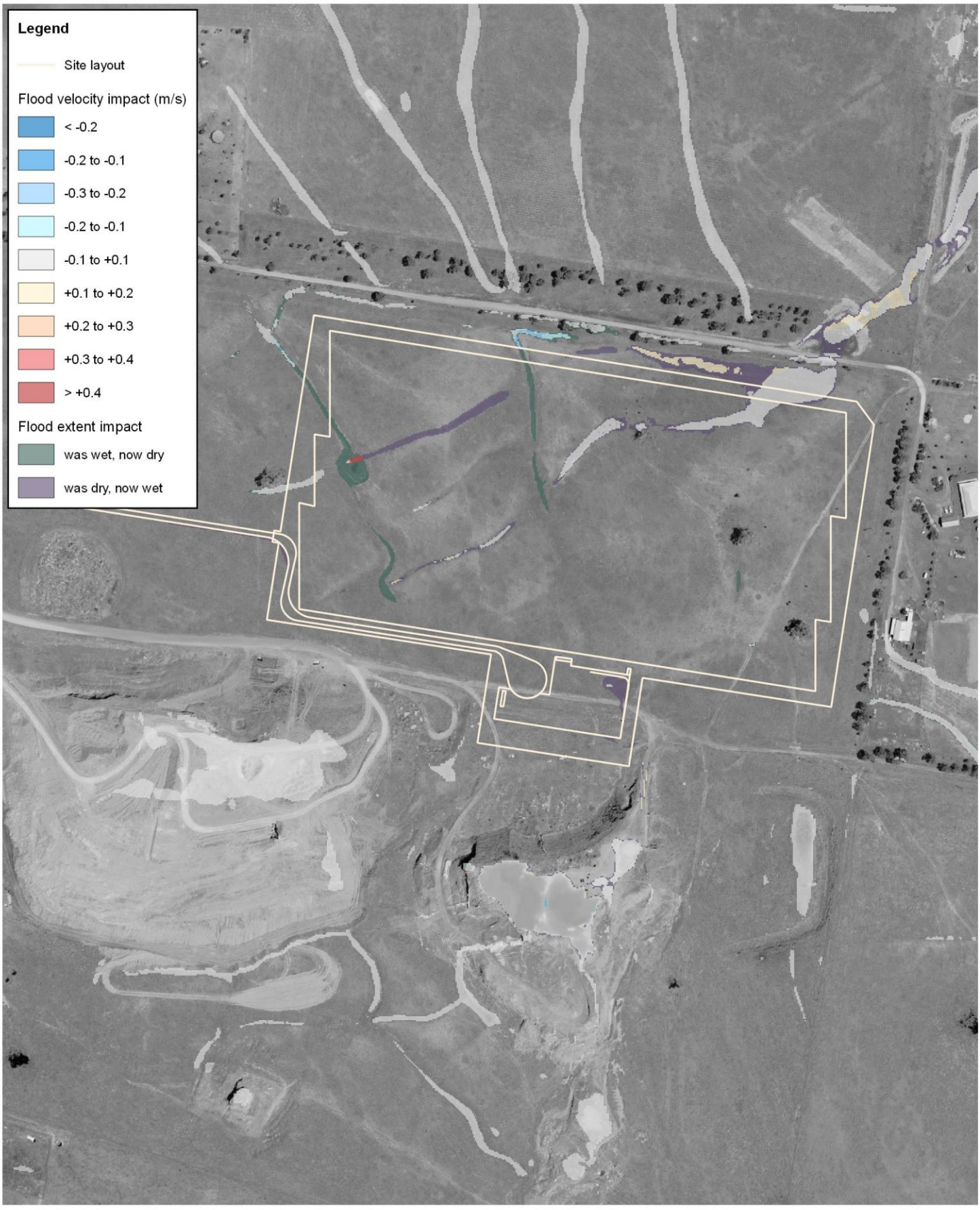
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Title:

Modelled 1% AEP Peak Flood Velocity Impact

0 100 200 m

approx. scale

Figure: 14

Revision: A

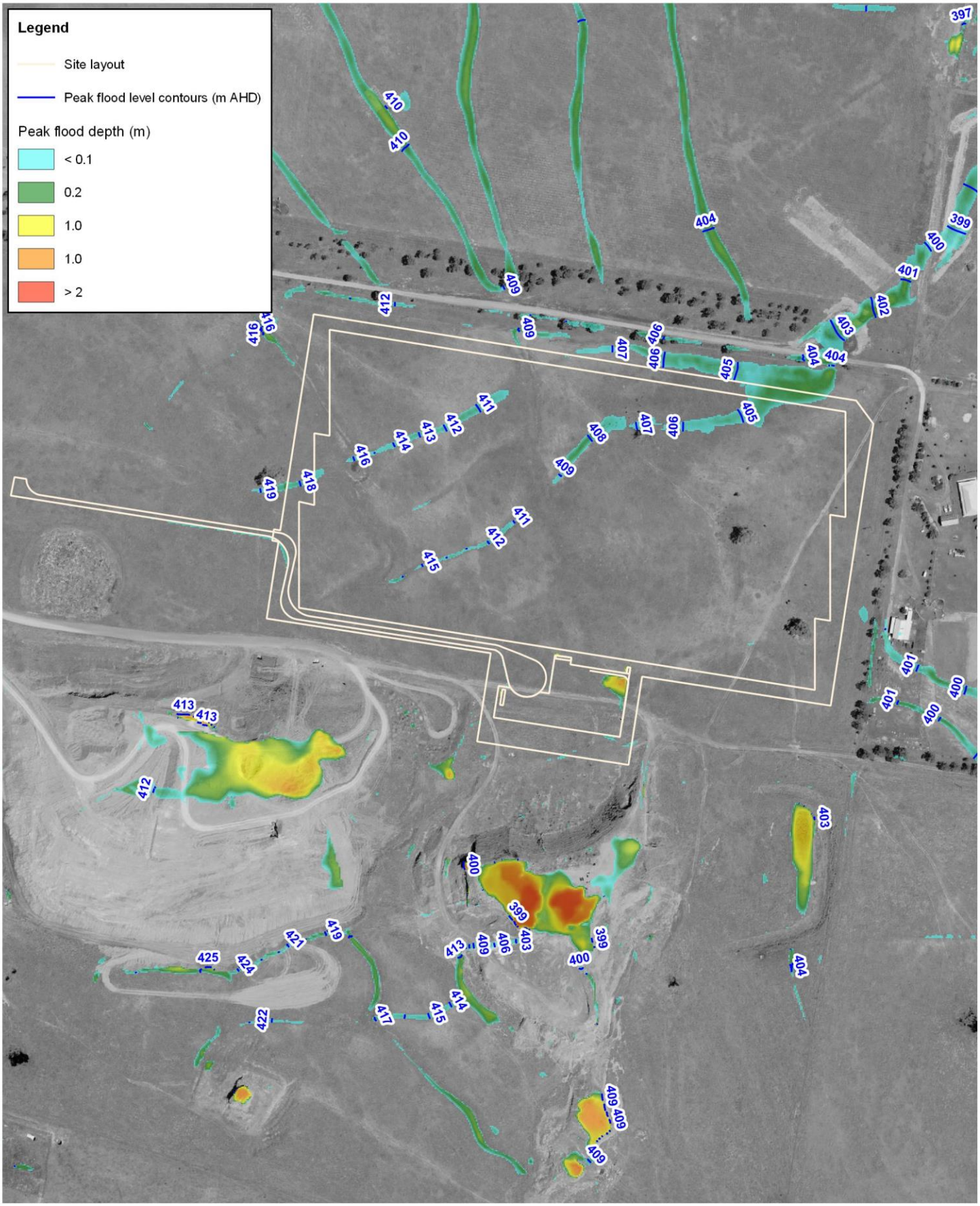
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Title:

Modelled 1% AEP Flood Depths and Levels Post-development Conditions

0 100 200 m

approx. scale

Figure: 15

Revision: A

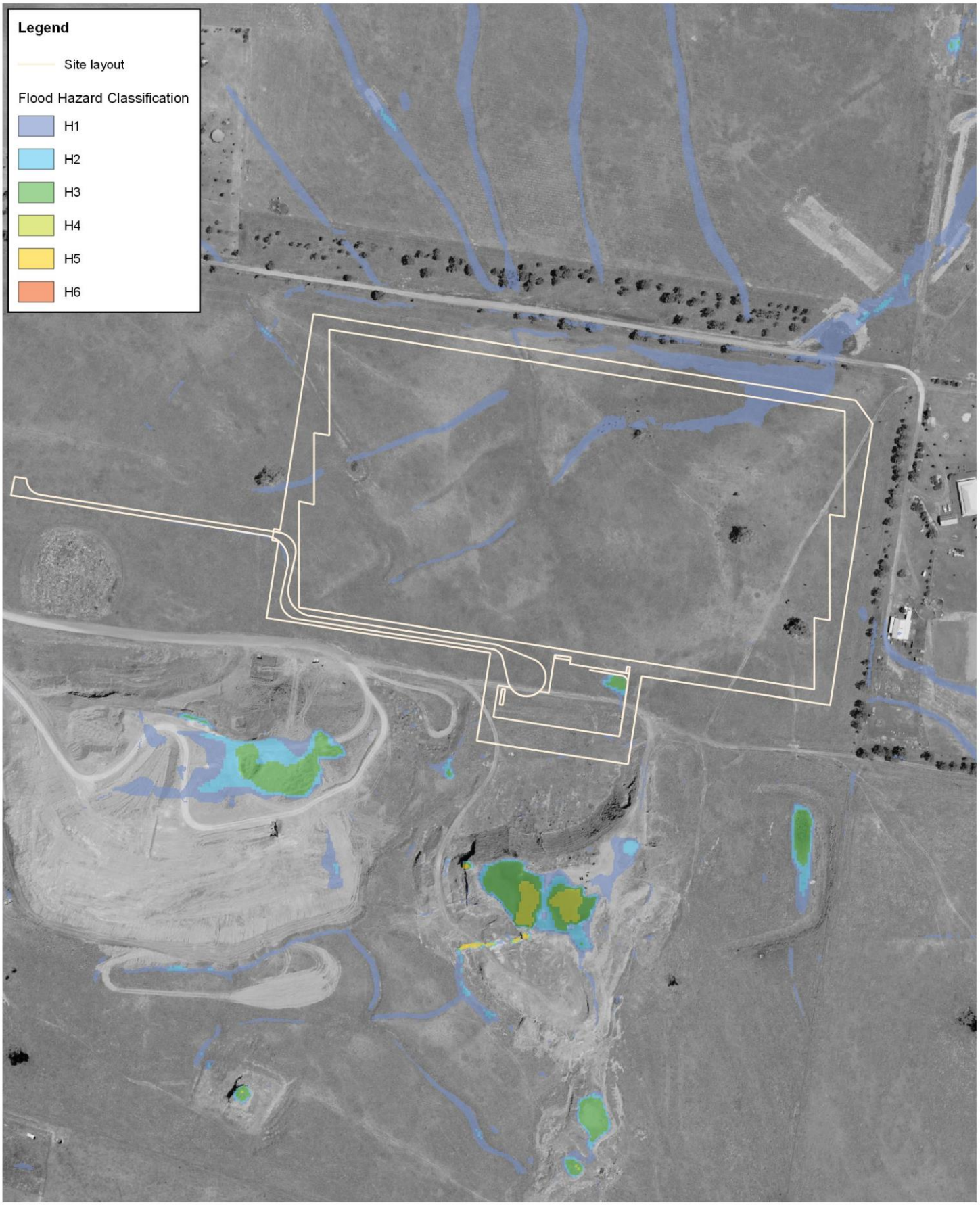
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Title:

Modelled 1% AEP Flood Hazard Classification Post-development Conditions

0 100 200 m

approx. scale

Figure: 16

Revision: A

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Our Ref: PR132455DCR_SOUTHTAMWORTH

Date: 23 March 2020

MAKING COMPLEX EASY
Unit 2A, 45 Fitzroy Street
Carrington NSW 2294
T +61 2 4940 4200

Attn: ROSIE TURNER
KDC PTY LTD
SUITE 2B, 125 BULL STREET
NEWCASTLE WEST NSW 2302

Dear Rosie,

RE: PROPOSED SOLAR PROJECT
SUTTONS QUARRY, COUNTRY ROAD WESTDALE NSW

As requested and in accordance with your supplied documentation please find attached our Detailed Cost Report for the above totalling **$6,952,819 *including GST***.

Please note:

- The above noted amount includes for “construction” costs only; and
- We refer you to the *Schedule of Exclusions*.

We trust this information is sufficient for your purposes, however should you require any further details or clarification, please do not hesitate to contact the writer.

Yours sincerely

RPS



Ryan Scott
Senior Quantity Surveyor
BConMgt (BLDG) (Hons), MAIQ

Proposed Solar Project - South Tamworth

Job Name :	PR132455CIV_ST_DCR	**Job Description**	
Client's Name:	ProvidenceInvestmentManagement	Proposed Solar Project - Suttons Quarry, Country Road Westdale NSW	

Trd No.	Trade Description	Trade %	Cost/m2	Trade Total
1	Sediment & Erosion Control	0.25		17,355
2	Site Clearance	0.42		28,925
3	Preparation Works/ Earthworks	2.08		144,625
4	Pavement Works	2.50		173,700
5	Fencing & Landscaping	1.62		112,375
6	External Services	0.18		12,500
7	Solar Arrays	76.30		5,305,114
8	Preliminaries & Margin	6.67		463,568
9	GST exclusive "Construction" subtotal			*6,258,162*
10	Professional fees	0.90		62,582
11	GST exclusive subtotal			*6,320,744*
12	GST (10%)	9.09		632,075
13	GST inclusive total			*6,952,819*
14	SCHEDULE OF EXCLUSIONS			
		100.00		**6,952,819**

Final Total : $ 6,952,819

Schedule of Exclusions

Job Name :	PR132455CIV_ST_DCR	**Job Description**	
Client's Name:	ProvidenceInvestmentManagement	Proposed Solar Project - Suttons Quarry, Country Road Westdale NSW	

Item No.	Item Description	Quantity	Unit	Rate	Amount
Trade :	**14** ***SCHEDULE OF EXCLUSIONS***				
1	Land costs & legal fees		Note		**EXCL**
2	Authorities/Consultants fees & charges UNO		Note		**EXCL**
3	Holding costs & interest charges		Note		**EXCL**
4	Future costs escalation		Note		**EXCL**
5	Design development allowance		Note		**EXCL**
6	Unknown ground conditions or Engineering design		Note		**EXCL**
7	Work outside site boundaries UNO including any works associated with future Stages		Note		**EXCL**
8	Works outside of the scope as deemed by RPS		Note		**EXCL**
9	All items denoted as EXCL in the foregoing estimate		Note		**EXCL**
10	Contingency Sum		Note		**EXCL**
		SCHEDULE OF EXCLUSIONS	**Total :**		

SOUTH TAMWORTH SOLAR FARM

Reflective Glare Assessment

Prepared for:

KDC
Suite 2B, 125 Bull Street
NEWCASTLE WEST NSW 2302

SLR Ref: 620.13765-R01
Version No: -v1.3
April 2020

PREPARED BY

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North Sydney NSW 2060 Australia

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with KDC (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
620.13765-R01-v1.3	15 April 2020	Dr Peter Georgiou	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy
620.13765-R01-v1.2	7 April 2020	Dr Peter Georgiou	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy
620.13765-R01-v1.1	7 April 2020	Dr Peter Georgiou	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy
620.13765-R01-v1.0	31 March 2020	Dr Peter Georgiou	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy

EXECUTIVE SUMMARY

SLR Consulting Australia Pty Ltd (SLR) has been engaged by KDC to carry out a Reflective Glare assessment of the proposed South Tamworth Solar Farm (the "Project") under development by Providence Asset Group. The Project is located in Westdale, 6 km southwest of Tamworth town centre, NSW. Tamworth Airport is located 3.5 km to the northwest.

The proposed (up to) 5 MWac facility will comprise 14,196 solar PV panels within a 13.25 ha project site area. The 425 W panels, measuring 2 m by 1 m, will be positioned as currently understood on single-axis trackers oriented north-south with a spacing of 6 m. At their maximum tilt angle of 60° the height of the panels relative to local ground level is 2.73 m.

Section 2 describes the footprint and envelope of the proposed South Tamworth Solar Farm.

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels within the facility
- Night-time Illumination glare from 24/7 operational security lighting within the facility

In terms of potential glare scenarios, the following has been considered:

- Aviation Sector Reflective Glare;
- Motorist "Disability" Reflective Glare and Pedestrian "Discomfort" Reflective Glare;
- Rail Operator Reflective Glare;
- Industrial critical machinery operators (heavy vehicles, etc) Reflective Glare; and
- Residential "Nuisance" Glare from daytime reflections or night-time illumination.

In all cases, the present study has found that the potential for adverse glare from the proposed facility will be negligible, due to a combination of factors, including:

- The choice of a single axis tracking mounting system and the distances to nearest receivers of interest in relation to aviation, road traffic, rail traffic and residential.

To avoid the potential for potential glare occurrences along Runway 36 for the theoretical "Zero" Tilt scenario, ie any situation where the tilting action of the solar array is disabled (eg maintenance works, etc), it is recommended that, during the months of September to April, panels should not be left horizontal in such circumstances, but be left tilted to the east, with a minimum tilt angle of 10° or greater.

There should be negligible impact if 24/7 lighting is required on the site for operational purposes, assuming the lighting design is in accordance with AS 4282-1997 *Control of the Obtrusive Effect of Outdoor Lighting*. This would also address any potential adverse eco-lighting issues in relation to nocturnal fauna within and surrounding the site, although, as far as is known, no biodiversity issues have been identified in relation to the Project.

When key Project decisions are finalised during detailed design (eg final panel selection, mounting details, etc), the present analysis should be re-visited to confirm the conclusions set out above if key assumptions made in the analysis change significantly.

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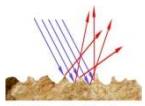
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APPENDICES

Appendix A SGHAT Ocular Plot Analysis Results

Abbreviations and Definitions

Terms relevant to Daytime Reflective Glare	
PV Panel	Photovoltaic (PV) panels are designed to absorb solar energy and retain as much of the solar spectrum as possible in order to produce electricity
Glare	Glare refers to the reflections of the sun off any reflective surface, experienced as a source of excessive brightness relative to the surrounding diffused lighting. Glare covers reflections experienced by both stationary and moving observers (the latter sometimes referred to as "glint") and reflections which are either specular or diffuse.
Specular	A reflection which is essentially mirror-like – there is virtually no loss of intensity or angle dispersion between the incoming solar ray and outgoing reflection  Specular Reflection
Diffuse	A reflection in which the outgoing reflected rays are dispersed over a wide ("diffuse") range of angle compared to the incoming (parallel) solar rays, typical of "rougher" surfaces  Diffuse Reflection
KVP	Key View Points (KVPs) are offsite locations where receivers of interest have the potential to experience adverse reflective glare

Terms relevant to Night-Time Illumination	
Spill light	Light emitted by a lighting installation, which subsequently falls outside the boundaries of the property on which the installation is sited.
Obtrusive light	Spill light which, because of quantitative, directional or spectral attributes in a given context, gives rise to annoyance, discomfort, distraction or a reduction in the ability to see essential information, eg traffic lights.
Luminaire	Apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except for the lamps themselves, all the parts necessary for fixing and protecting the lamps and, where necessary circuit auxiliaries together with the means for connecting them to the electrical supply.
Luminous intensity	The concentration of luminous flux emitted in a specific direction. Unit: candela (Cd).
Luminance **AS 1158.2:2005**	This is the physical quantity corresponding to the brightness of a surface (e.g. a lamp, luminaire or reflecting material such as façade glazing) when viewed from a specified direction. Unit: Cd/m^2
Illuminance **AS 1158.2:2005**	This is the physical measure of illumination. It is the luminous flux arriving at a surface divided by the area of the illuminated surface – the unit is lux (lx): 1 lx = 1 lm/m^2 The term covers both "Horizontal Illuminance" (the value of illuminance on a designated horizontal plane at ground level) and "Vertical Illuminance" (the value of illuminance on a designated vertical plane at a height of 1.5m above ground level).
Glare **AS 1158.2:2005**	Condition of vision in which there is a discomfort or a reduction in the ability to see, or both, caused by an unsuitable distribution or range of luminance, or to extreme contrast in the field of vision. Glare can include: (a) Disability Glare – glare that impairs the visibility of objects without necessarily causing discomfort. (b) Discomfort Glare – glare that causes discomfort without necessarily impairing the visibility of objects.
Threshold Increment (TI) **AS 4282-1997**	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.

1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been engaged by KDC to carry out a Reflective Glare assessment of the proposed South Tamworth Solar Farm (the "Project") under development by Providence Asset Group. The Project is located in Westdale, 6 km southwest of Tamworth town centre, NSW. Tamworth Airport is located 3.5 km to the northwest.

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels within the facility
- Night-time Illumination glare from 24/7 operational security lighting within the facility

1.1 Structure of Report

The remainder of this report is structured as follows:

- **Section 2** describes the Project and surrounding environment;
- **Section 3** describes the range of receptors surrounding the site with the potential to experience adverse reflective glare (or glint);
- **Section 4** presents the acceptability criteria used for the study;
- **Section 5** addresses the assumptions made in the glare impact analysis;
- **Section 6** presents the results of the glare impact analysis of the Project;
- **Section 7** presents the conclusions of the study.

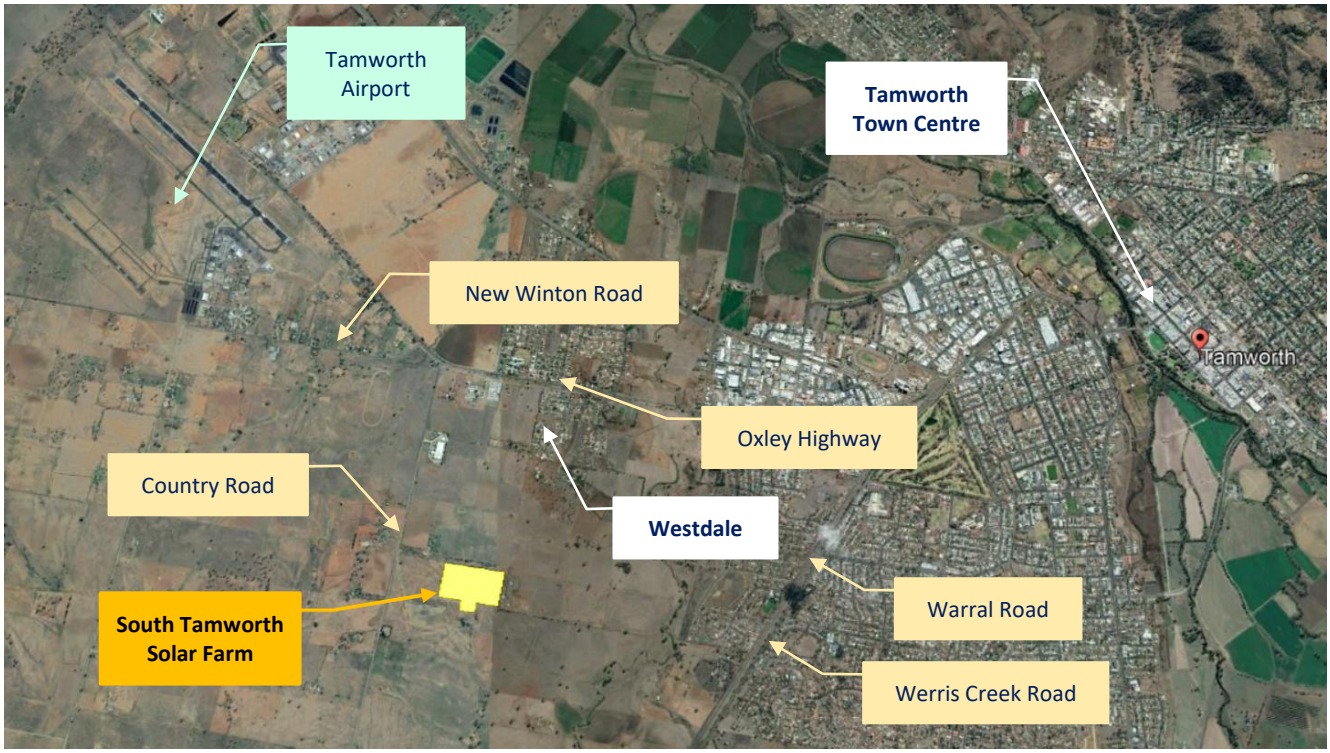
2 PROPOSED SOUTH TAMWORTH SOLAR FARM PROJECT

2.1 Site Location

The Project is seeking approval for an (up to) 5 MWac photovoltaic (PV) solar plant occupying a 13.25 ha area as shown in **Figure 1**. The Project is located in Westdale, 6 km southwest of Tamworth town centre, NSW. Tamworth Airport is located 3.5 km to the northwest.

The land required for the Project has been subject to constraints identified by site investigation, i.e. native vegetation, and areas of cultural or heritage significance. The plan of the Project has been developed following completion of these site investigations and the assessment of any constraints and their impact.

Figure 1 South Tamworth Solar Farm - Location Map



2.2 Site Description and Key Project Components

From a Reflective Glare point of view, the key components of the Project are:

- the photovoltaic (PV) modules in relation to their daytime reflective glare potential; and
- the facility's security/emergency lighting design in relation to potential night-time illumination glare issues (if such 24/7 lighting is incorporated into the Project).

Solar Panel Mounted Array – refer Figure 2

The proposed ground-mounted array (refer **Figure 2(a)**) would consist of trackers oriented in a north-south direction, supporting a total of 14,196 x 425W solar panels:

- The trackers are "single-axis" capable of rotating solar panels to a maximum of ±60° - refer **Figure 2(b)**;
- The trackers are oriented north-south and spaced 6 m apart; and
- Individual panels (2.0m x 1.0m) reach a maximum height above ground of 2.73 m at their full 60° tilt angle;
- The western perimeter of the Project lies 390 m from Country Road (to the west); the northern-most tracker is located approximately 1.5 km from the nearest major thoroughfare, the Oxley Highway.

Figure 2 South Tamworth Solar Farm Site Layout

(a) Site Layout

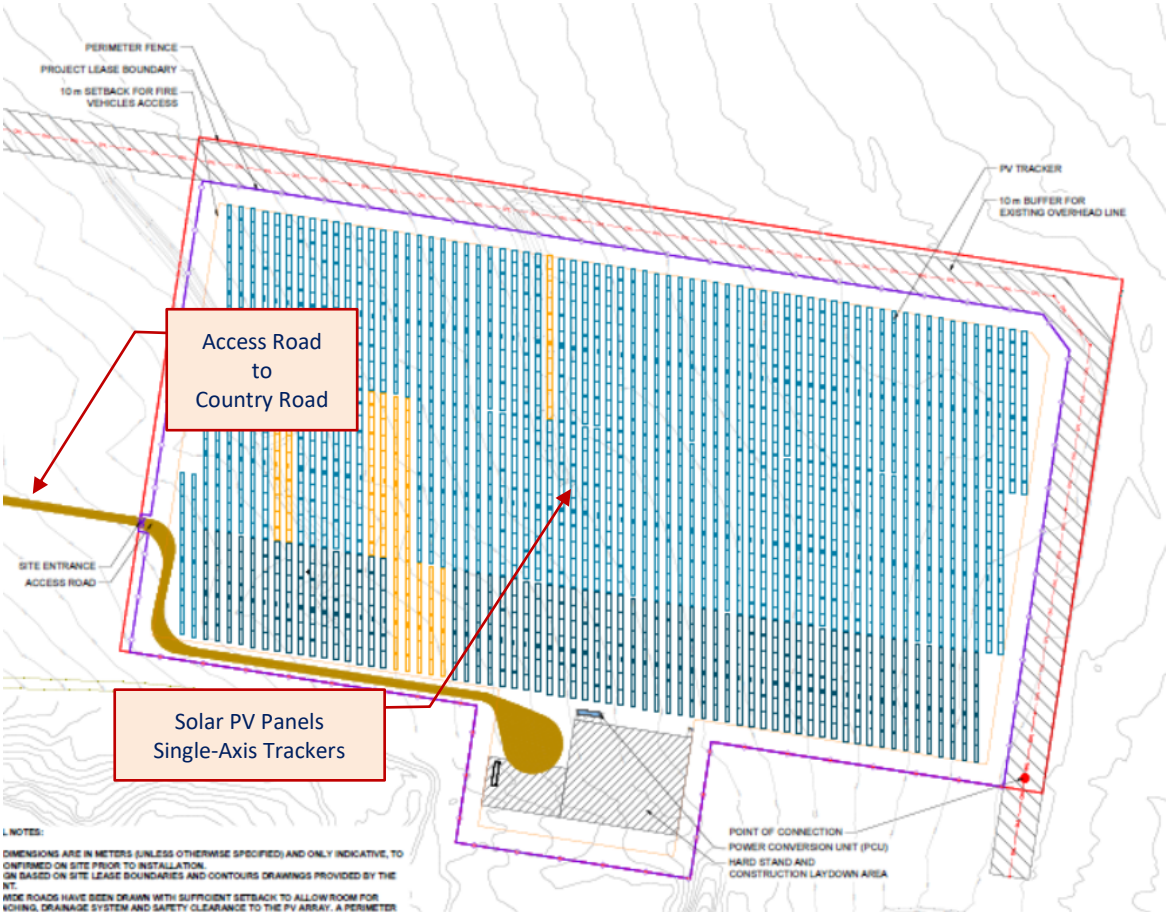
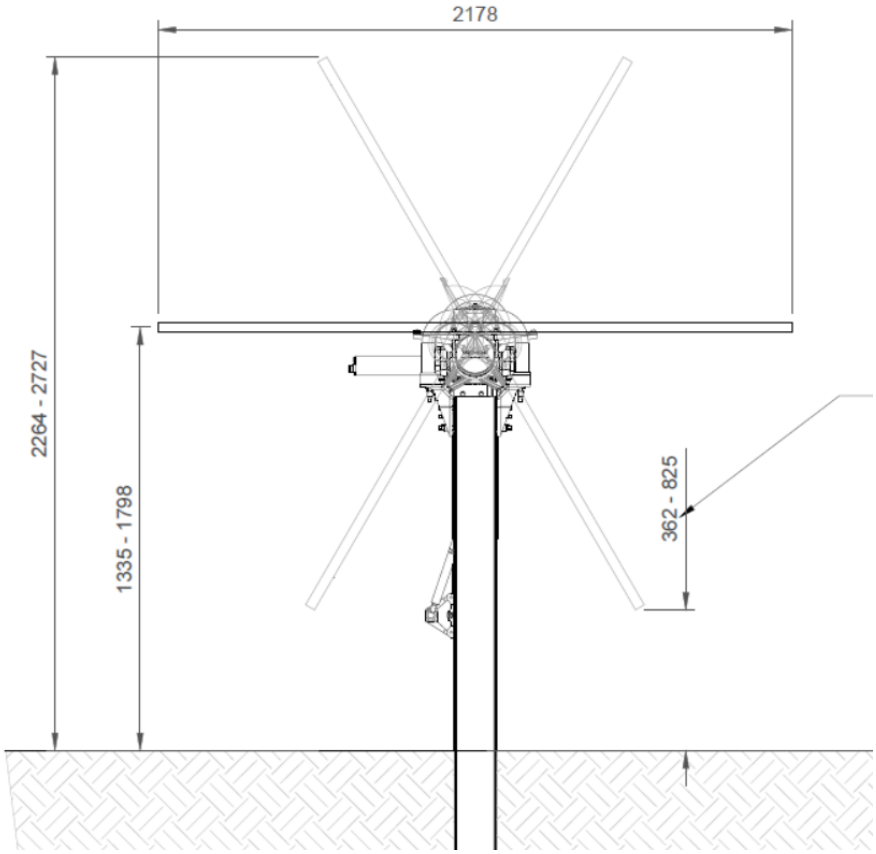


Fig.2 (cont'd)

(b)
Single-Axis Tracker Profile (±60° Tilt)



3 RECEIVERS AND ASSOCIATED IMPACTS

3.1 Receiver Impacts

The issues of concern in relation to daytime reflective glare and night-time illumination glare and the associated receivers of interest are detailed below.

Aviation-Related Glint & Glare (Aircraft, Helicopters, Airport Control Towers)

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.

Motorist Traffic Disability Glare on the surrounding road network

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).

Train Driver Disability Glare on the surrounding rail network

The issue of concern here is the potential impact of reflective glare interfering with or distracting a train operator's activities or the potential for reflections to obscure railway signals.

Industrial Critical Machinery Operators (draglines, heavy trucks, etc)

The issue of concern here is the potential impact of reflective glare interfering with or distracting the operators of critical industrial machinery.

Residential Nuisance Glare on surrounding receivers

The issue of concern here is the potential "nuisance" caused by extended periods of reflective glare.

Nearest neighbours may also be impacted by light spill from night-time illumination.

3.2 Nearest Receiver Locations

Receivers of interest relevant to the Project are shown in:

Figure 3 Nearest Airfields.

Figure 4 Surrounding road network.

Figure 5 Surrounding rail network.

Figure 6 Nearest representative residential and sensitive receivers.

Figure 3 Nearest Airfield to Project Site

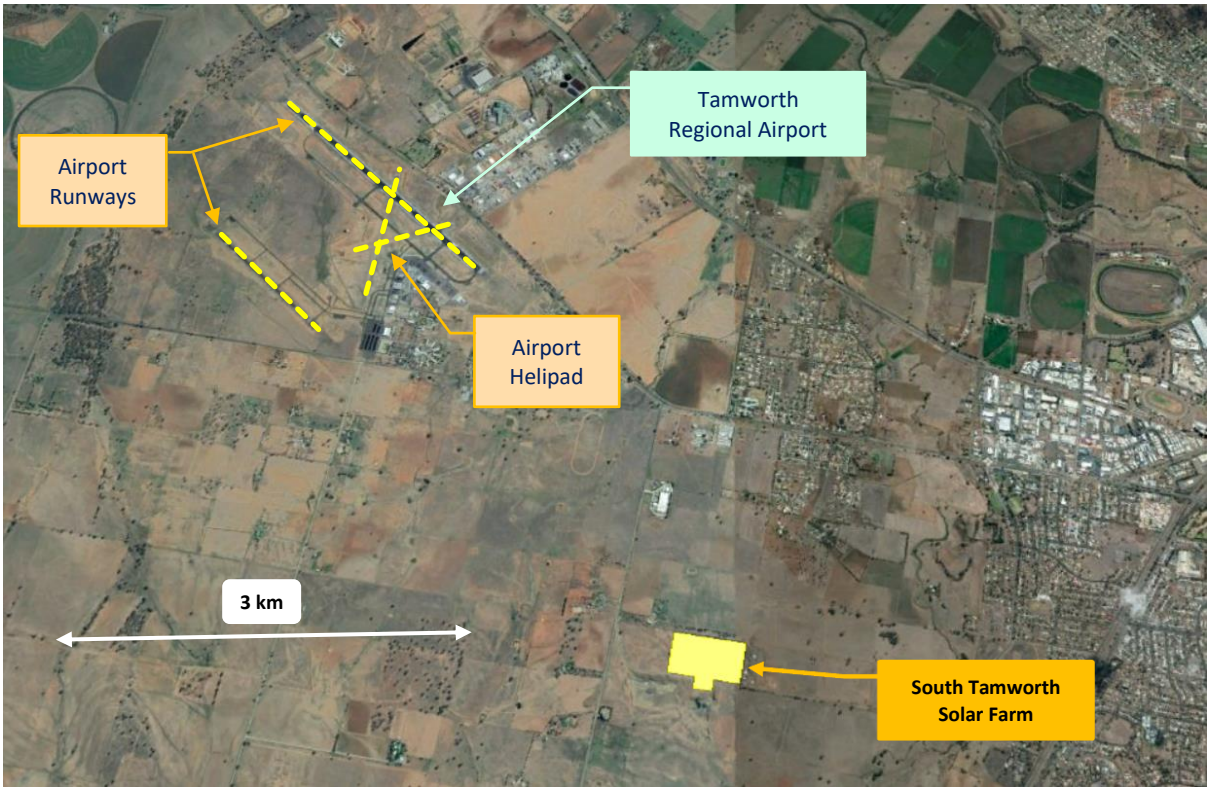


Figure 4 Surrounding Road Network



Figure 5 Surrounding Rail Network and NSW Rail Map

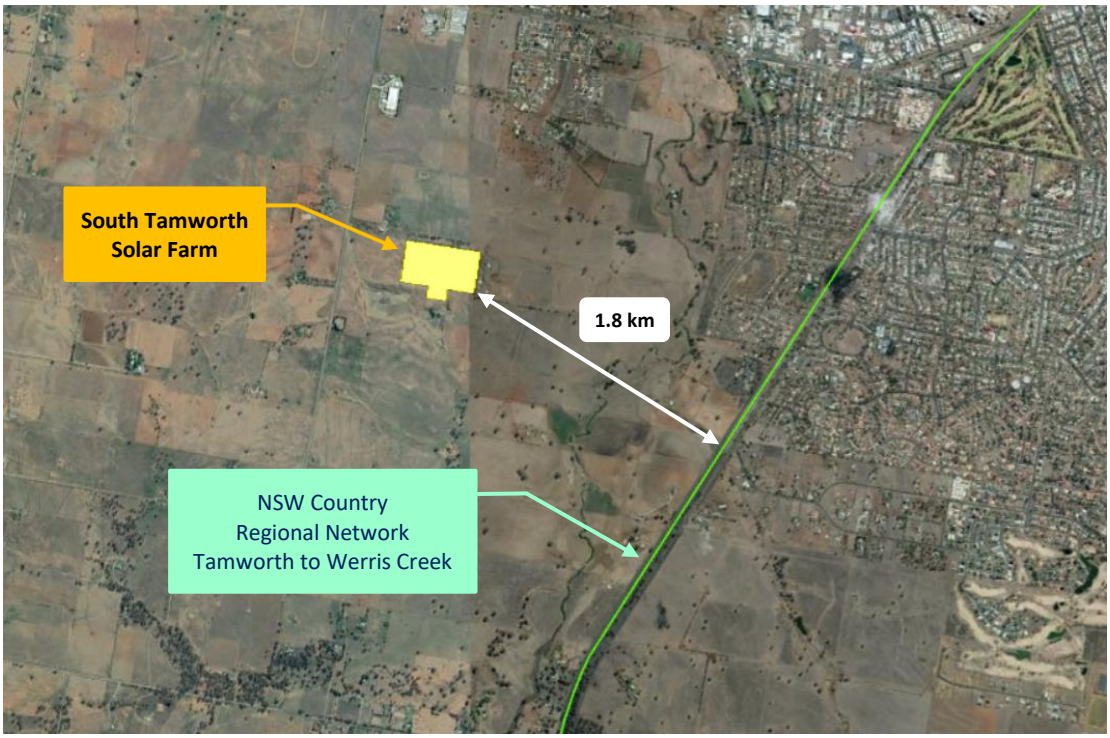
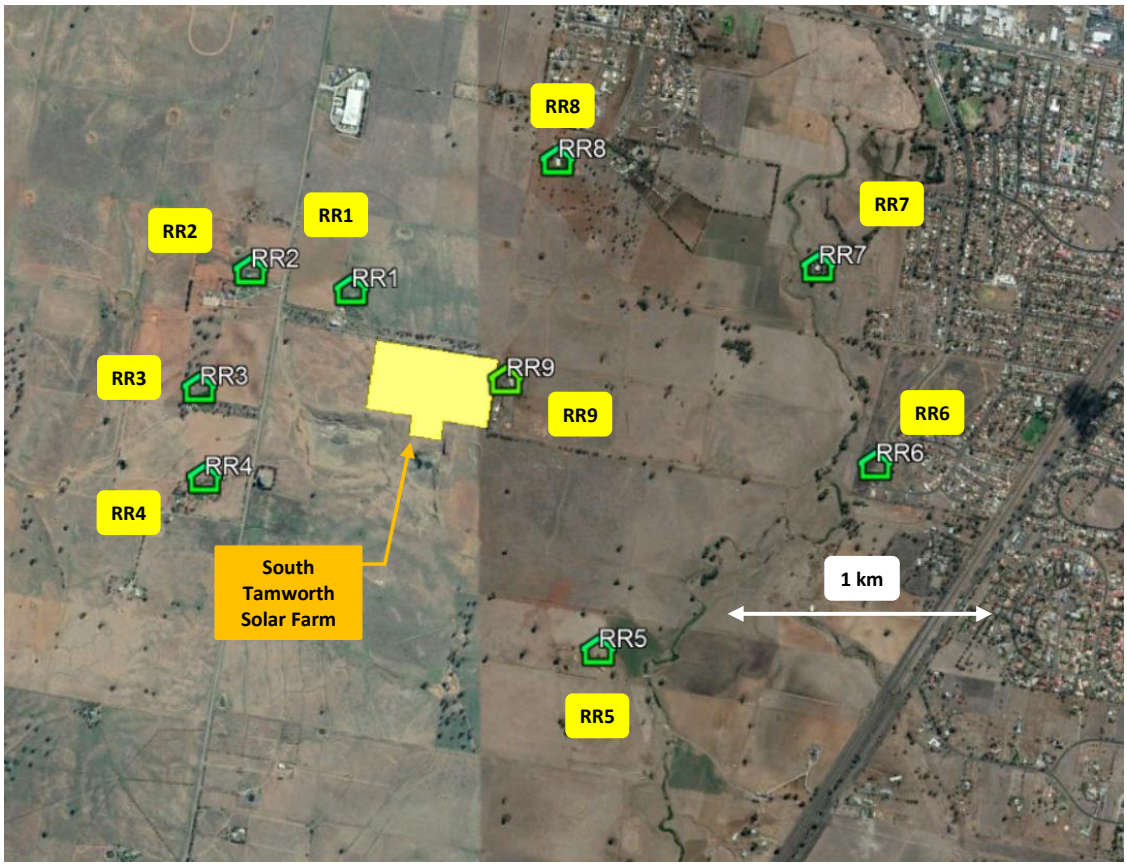


Figure 6 Nearest Representative Residential (RR) Receivers



4 GLARE ACCEPTABILITY CRITERIA

In relation to **daytime** reflective glare impact, the Project contains the following elements of interest:

- PV modules using solar panels on the Project ground array;

In relation to **night-time** illumination glare impact, the Project may include the following elements of interest:

- 24/7 lighting for access roads to enable site maintenance, fire and other emergency events, and 24/7 lighting for the on-site Operations & Maintenance building and power station/substation which provide connection to the local distribution network.

4.1 Aviation Sector Reflective Glare

The impact of solar PV systems on aviation activity is something that solar developers today are addressing more and more often, given the (global) proliferation of solar projects, in particular those located either within or around airport precincts.

Guidance in this area is available from two sources – UK CAA and US FAA.

US FAA

The reader is referred to the following technical references:

- Brumleve (various, 1976-1984), Ho, Ghanbari & Diver (2009, 2010) and Ho & Khalsa (2010)

The FAA regulates and oversees all aspects of American civil aviation. On the basis of 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.

- FAA, *"Technical Guidance for Evaluating Selected Solar Technologies on Airports"*, Federal Aviation Administration, Washington, D.C., November 2010.
- FAA, *"Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports"* Federal Register, Oct. 23, 2013,
- FAA, *"Technical Guidance for Evaluating Selected Solar Technologies on Airports"*, Federal Aviation Administration, Washington, D.C., Version 1.1, April 2018.

In support of the above, the FAA contracted Sandia Labs to develop their **Solar Glare Hazard Analysis Tool** (SGHAT) software as the standard tool for measuring the potential ocular impact of any proposed solar facility on a federally obligated airport. SGHAT utilises the Solar Glare Ocular Hazard Plot to determine and assess the potential for glare. SGHAT is described in the following references:

- Ho, C.K., Ghanbari, C.M. and Diver, R.B.,, *"Methodology to Assess Potential Glint and Glare Hazards from Concentrating Solar Power Plants: Analytical Models and Experimental Validation"*, J. Solar Engineering, August 2011, Vol.133, 031021-1 to 031021-9.
- Ho, C.K. & Sims, C., *"Solar Glare Hazard Analysis Tool (SGHAT) User's Manual v2.0"*, Sandia National Laboratories, Albuquerque, NM. August 2013.

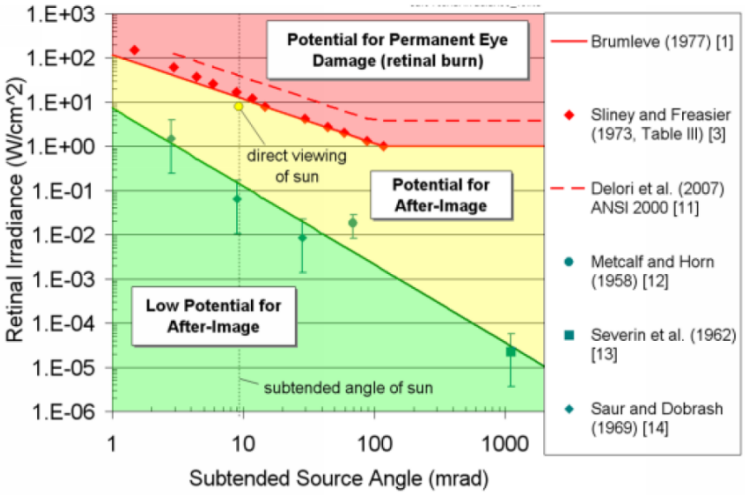
A sample Solar Glare Ocular Hazard Plot is shown in **Figure 7** along with reference sources which contributed to the delineation of various hazard "zones". The SGHAT criteria state that a proposed solar facility should satisfy the following:

- Airport Traffic Control Tower (ATCT) cab NO Glare
- Final approach paths for landing aircraft Glare to NOT exceed "Low Potential for After-Image"

The criteria also state:

- Ocular impact must be examined over the entire calendar year in 1-minute intervals, sunrise to sunset.
- Both existing and planned ATCT cabs should be examined for potential glint and glare.
- Both existing and planned landing thresholds should be examined for potential glint and glare.

Figure 7 Example Solar Glare Ocular Plot (SGHAT Software Output)



4.2 Motorist "Disability" Glare and Pedestrian "Discomfort" Glare

The criteria commonly used by Local Government Authorities to assess the acceptability or otherwise of road traffic glare events utilise the so-called **Threshold Increment** (TI) Value of the reflection condition (refer **Abbreviations and Definitions**). 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.

4.3 Rail Operators Reflective Glare

Almost all Australian Rail Authorities have guidelines covering glare in general (ie not specific to solar PV panel glare) aimed at avoiding discomfort/distraction to train operators and obscuring train signals. Most guidelines refer either to Table 2.10 of AS 1158.3.1 for the TI Value criterion and/or Table 3.2 of AS 1158.4 for the Cd (Candela) criterion associated with the control of glare.

- For Rail Traffic Disability Glare, the relevant AS1158 criteria are:
  - The TI Value should remain below 20%
  - The Cd Value at 70° incidence should remain below 6,000.

4.4 Residential "Nuisance" Glare

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

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 that exists 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:

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

4.5 Industrial Critical Machinery Operations

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 Traffic Disability Glare, can assist when dealing with this issue.

The issue most commonly arises in relation to mining operations where machinery operators can be located in elevated locations, eg dragline operations, where a line of sight may be possible to a solar facility located in close proximity. Ports with their observation towers are another potential source of elevated receivers of interest if located adjacent to a solar facility.

No such industrial operations exist in the present case.

4.6 Night-Time Illumination Glare

The effect of light spill from outdoor lighting impacting on residents, transport users, transport signalling systems and astronomical observations is governed by AS 4282-1997.

The adverse effects of light spill from outdoor lighting are influenced by a number of factors:

- The topology of the area. Light spill is more likely to be perceived as obtrusive if the lighting installation is located higher up than the observer. Lighting installations are usually directed towards the ground and an observer could hence have a direct view of the luminaire.
- The surrounding area. Hills, trees, buildings, fences and general vegetation have a positive effect by shielding the observer from the light installation.
- Pre-existing lighting in the area. Light from a particular light source is seen as less obtrusive if it is located in an area where the lighting levels are already high, eg in cities. The same lighting installation would be seen as far more bothersome in a less well-lit residential area.
- The zoning of the area. A residential area is seen as more sensitive compared to commercial areas where high lighting levels are seen as more acceptable.

Typical illuminance levels for a variety of circumstances are given in **Table 1** for comparison.

Table 1 Typical Illuminance Levels for Various Scenarios

Lighting Scenario	Horizontal Illuminance (lux)
Moonless overcast night	0.0001
Quarter Moon	0.01
Full Moon	0.1
Twilight	10
Indoor office	300
Overcast day	1,000
Indirect sunlight clear day	10,000-20,000
Direct sunlight	100,000-130,000

Recommended criteria of light technical parameters for the control of obtrusive lighting are given in **Table 2**. The vertical illuminance limits for *curfew hours* apply in the plane of the windows of habitable rooms or dwellings on nearby residential properties. The vertical illuminance criteria for *pre-curfew hours* apply at the boundary of nearby residential properties in a vertical plane parallel to the boundary.

Values given are for the direct component of illuminance, i.e. no reflected light is taken into account.

- Limits for luminous intensity for *curfew hours* apply in directions where views of bright surfaces of luminaires are likely to be troublesome to residents, from positions where such views are likely to be maintained.
- Limits for luminous intensity for *pre-curfew* hours apply to each luminaire in the principal plane, for all angles at and above the control direction.

Table 2 Recommended Maximum Values of Light Technical Parameters (AS4282-1997)

Light Technical Parameter	Time of Operation	Commercial Areas	Residential Areas	
			Light Surrounds	Dark Surrounds
Illuminance in vertical plane (E_v)	Pre-curfew hours	25 lx	10 lx	**10 lx**
	Curfew hours	4 lx	2 lx	**1 lx**
Luminous Intensity emitted by luminaires (I)	Pre-curfew hours	7,500 Cd (for a medium to large area with Level 1 control)	100,000 Cd (for a large area with Level 1 control)	100,000 Cd (for a large area with Level 1 control)
	Curfew hours	2,500 Cd	1,000 Cd	500 Cd

The Project is located on the outskirts of Tamworth and has the potential to impact on surrounding residential properties – refer **Figure 7**. Some of these properties are not located within township environs proper and would therefore be classed as being in a residential area with "Dark Surrounds" - refer **Table 2**.

The applicable limits for adverse spill light will depend on the time of operation for the lighting installation.

For the Project, it is possible that internal access roads and any equipment buildings in particular, will be operational 24/7, suggesting the application of the more restrictive limit relevant to *curfew hours*.

Accordingly:

- Light spill from the Project onto the facades of the surrounding residential dwellings should be kept below 1 lux during curfew hours.

Finally, it has been known for some time that night-time artificial lighting has the potential to disrupt the natural behaviour of nocturnal fauna species such as arboreal mammals, large forest owls and microbats. The standards mentioned above do not contain limiting lux levels in relation to the mitigation of such eco-lighting impacts.

Mitigation recommendations in relation to adverse eco-lighting therefore centre on feasible night-time lighting minimisation, bearing in mind the provision of appropriate health and safety and security conditions given the nature of the site. Biodiversity associated with the Project is discussed in the Flora and Fauna Assessment Report prepared for the Project. As far as is known, no adverse eco-lighting issues are apparent.

5 GLARE IMPACT ASSESSMENT - ASSUMPTIONS

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels.
- Night-time Illumination glare if any 24/7 operational security lighting is located within the site.

5.1 Assumptions – Solar Panel Geometry

The glare assessment discussed 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 ±60°.
- The trackers are oriented north-south and spaced 6 m apart.
- Individual panels (2.0m x 1.0m) reach a maximum height above ground of 2.73 m at their full 60° tilt angle.
- The western perimeter of the Project lies 390 m from Country Road (to the west); the northern-most tracker is located approximately 1.5 km from the nearest major thoroughfare, the Oxley Highway.

5.2 Project Site Solar Angles – Annual Variations

One of the challenging issues encountered with daytime solar panel glare is the varying nature of the reflections, whose duration will vary with time of day and day of the year as the sun's rays follow variable incoming angles between the two extremes of:

- summer solstice - sunrise incoming rays from just south of east, maximum angle altitude rays at midday, sunset incoming rays from just south of west.
- winter solstice - sunrise incoming rays from the northeast, minimum angle altitude rays at midday, sunset incoming rays from the northwest.

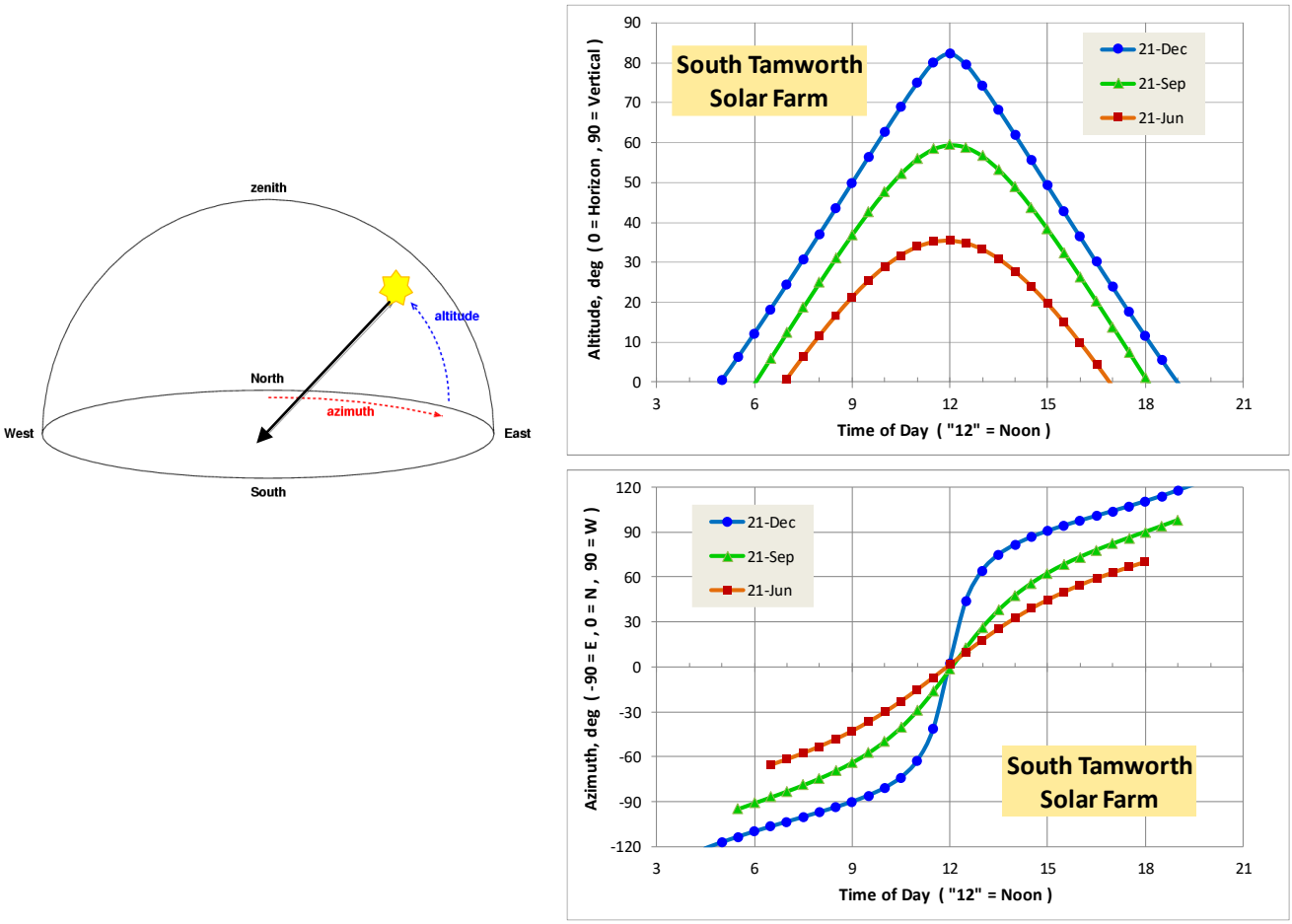
Any solar glare analysis must take into account the complete cycle of annual reflection variations noted above.

The potential range of incoming solar angles at the Project site relevant to daytime glare is shown in **Figure 8** with relevant critical angles summarised in **Table 3**.

Table 3 Key Annual Solar Angle Characteristics for Project Site

Day of Year	Sunrise	Sunset	Azimuth Range (sunrise-sunset)	Max Altitude
Summer Solstice	4:58 am	6:59 pm	118° E of North to 119° W of North	82.3°
Equinox	6:02 am	6:05 pm	91° E of North to 91° W of North	59.5°
Winter Solstice	6:57 am	4:54 pm	62° E of North to 61° W of North	35.5°

Figure 8 Project Site Incoming Solar Angle Variations

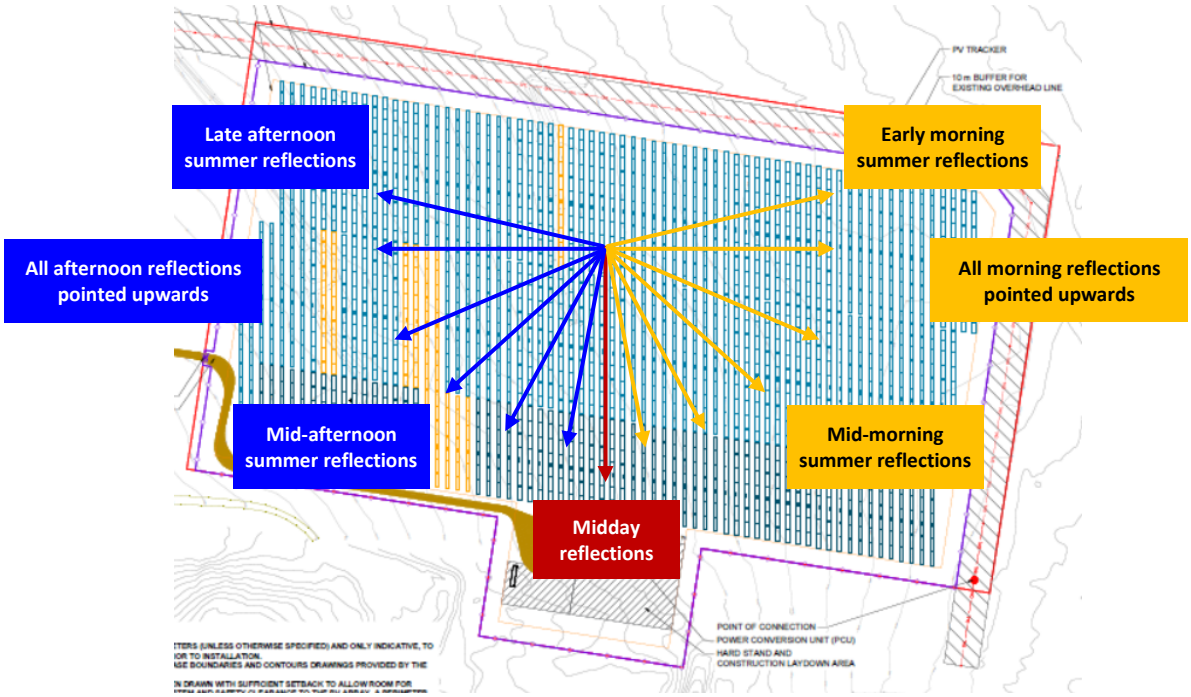


5.3 Project Solar Reflections

The project will use single-axis tracking panels (with the axis of rotation oriented north-south) as described in **Section 2.2**. In "plan" view, reflections from the project's panels will be directed as shown in **Figure 9** for a representative area of panels, with the direction of reflected rays shown for typical mid-summer days.

As a result of the tracking motion 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.

Figure 9 Potential Solar PV Panel Reflection Angles from the Project (typical mid-summer)



5.4 Solar Panel Reflectivity

Solar PV panels are designed to capture (absorb) the maximum possible amount of light within the layers below the front (external) surface. Consequently, solar PV panels are designed to minimise reflections off the surface of each panel. Reflections 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).
- 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

Representative reflectivity curves are shown in **Figure 10**.

Figure 10 Typical Reflectivity Curves as a Function of Incidence Angle

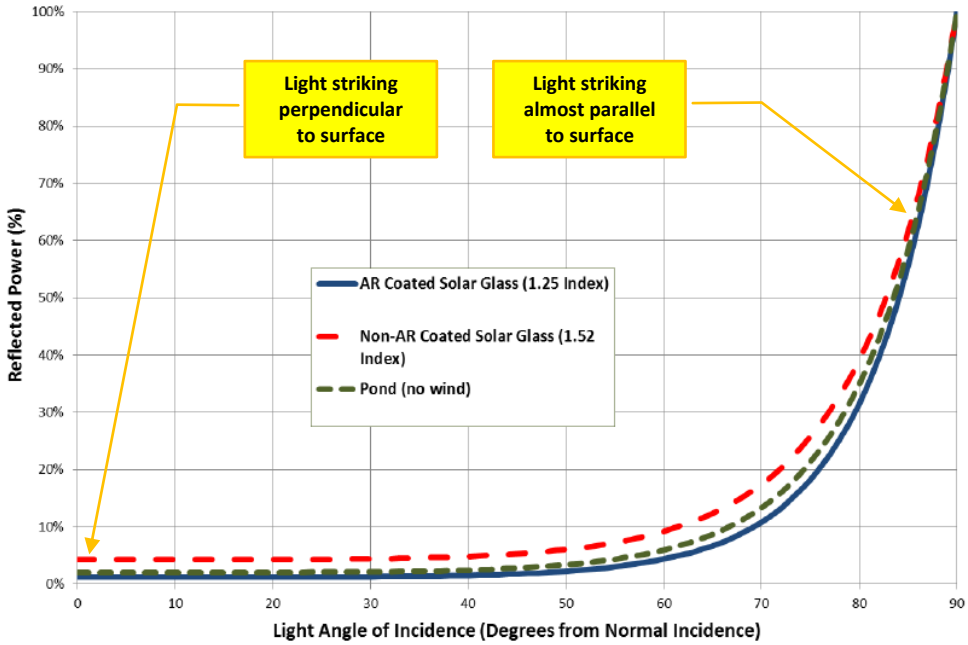


Figure 10 shows that:

- 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 "incidence" 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.
- However, for very high incidence angle, 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.

6 GLARE IMPACT ASSESSMENT - RESULTS

6.1 Aviation Sector Reflective Glare

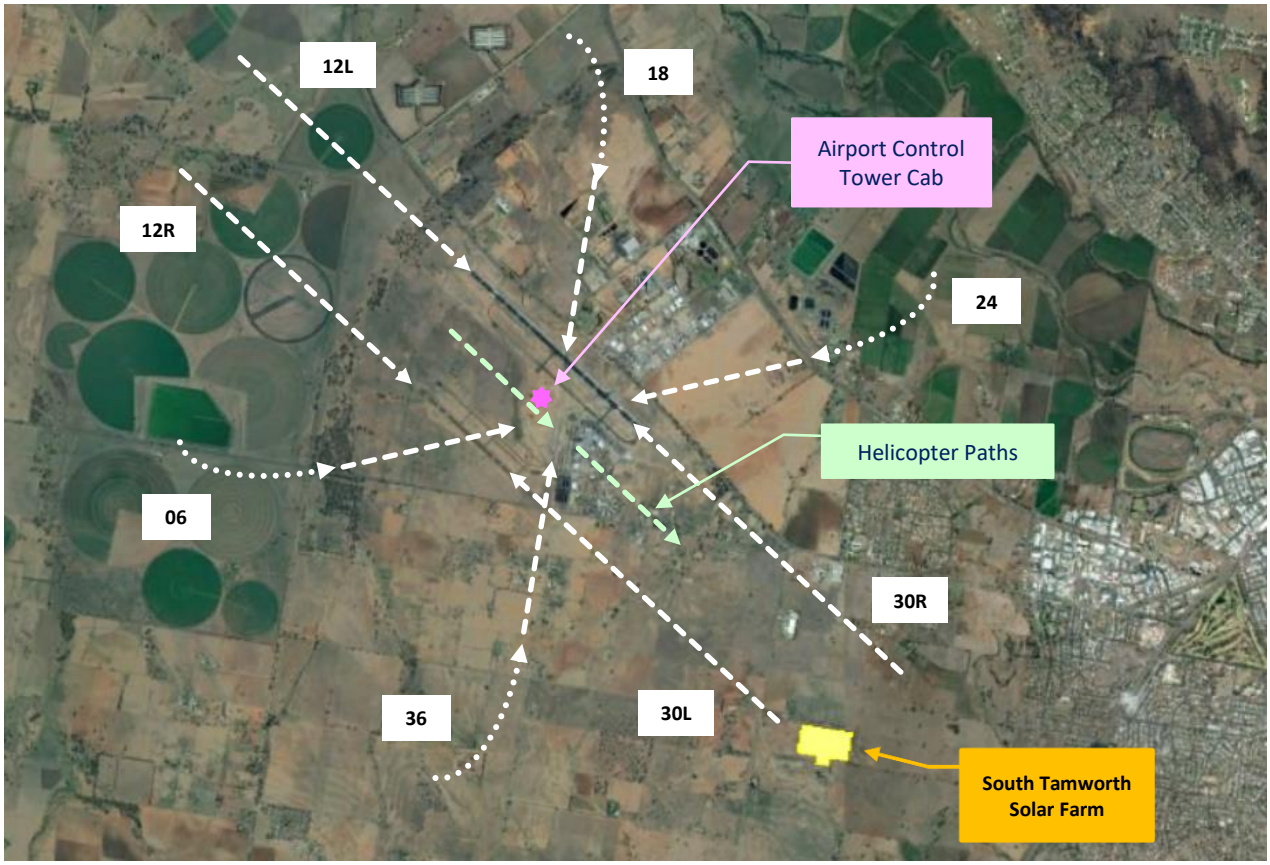
Tamworth Regional Airport (IATA: TWM, ICAO: YSTW) is the nearest major airport. It is located approximately 3 km northwest of the Project. The airport is serviced by QANTASLINK (Eastern Australia Airlines) and VIRGIN, as well as general aviation aircraft and helicopters.

- The main 2,200 m long asphalt Runway 12L/30R is oriented roughly northwest-southeast.
- A secondary 1,110 m long asphalt Runway 12R/30L is located 1 km southwest of 12L/30R.
- The airport has two secondary runways: the 1,020 m grass-clay Runway 18/16, oriented roughly north-south and the 842 m grass-clay Runway 06/24, oriented roughly southwest-northeast.

Figure 11 shows (landing) flight paths of interest:

- The airport's two main asphalt runways are essentially in a direct line of sight with the Project for aircraft in a final landing approach path.
- The airport's secondary runways are closer to perpendicular to the line of sight for landing aircraft. However, there is potential for aircraft approaching these runways to have a curved flight track that would see them at least partially in a direct line of sight of the Project prior to "straightening up" on their final approach path.
- Helicopter flight paths can be highly variable and landing approach paths in the direct line of sight of the Project are possible, although there is greater flexibility in adjusting helicopter flight paths if required.

Figure 11 Flight Path Geometry for SGHAT Analysis (Aircraft and Helicopters)



Accordingly, a quantitative analysis was carried out using the Sandia Labs Solar Glare Hazard Analysis Tool (SGHAT) software tool to examine potential worst-case scenario flight path approaches and take-offs and their ability to create adverse and unacceptable glare (and glint) conditions.

- The aircraft flight paths are all for landing scenarios (worst-case with the pilot looking downwards);
- The helicopter flight paths are for both landing and take-off in the same direction (as required by the SGHAT analysis protocol).

The flights paths assessed for the Project are shown in **Figure 11**.

SGHAT Modelling Assumptions:

- All runways were examined.
- A range of worst-case flight path scenarios has been assessed, named after their respective runway designations.
- For Runways 12L/30R and 12R/30L, landing flight paths are aligned to their respective the runways.
- For Runways 06/24 and 18/36, upstream curved paths were examined with a direct line of sight to the Project prior to straightening up on final approach.
- All aircraft landing flight paths are 2 miles in length, on a 3° glide path.
- Helicopter flight paths are also 2 miles in length and cover both landing and take-off in the same direction. Worst-case paths were assumed ranging in a direct line of sight to the Project.
- The SGHAT analysis examines ALL possible solar angles throughout the year
- The reflectivity of the PV panels was assumed to be the same as that shown in the standard solar glass shown in **Figure 10**.

In terms of the relative heights of flight paths and the solar farm:

- Ground elevations of South Tamworth Solar Farm range from 403 m to 425 m;
- Ground elevations below flight paths from the north and west are in the range 380 m to 400 m; and
- Ground elevations below flight paths from the east and south are in the range 400 m to 420 m.

Two “panel” scenarios were assessed:

- “Operational” scenario: panels can tilt ±60° about a north-south horizontal axis – this would be the normal operational mode for the solar farm;
- “Zero Tilt” scenario: panels remain fixed in a horizontal position – this is a scenario theoretically possible under a situation involving: shutdown, maintenance, pre-commissioning, etc

SGHAT Results

The SGHAT Ocular Plots results for all flight paths shown in **Figure 11** are presented in **Table 4** and in **Appendix A** (SGHAT Plots only for the NON-NIL results). The **Table 4** results refer to the number of minutes per annum that solar panel reflections are visible within any relevant SGHAT "zone" – refer **Figure 7**.

It will be recalled that solar panel reflections (glint and glare) are acceptable according to the FAA-SGHAT protocol if:

- There are no "Yellow" zone or "Red" zone results for aircraft or helicopter flight paths; and
- There are no "Green", "Yellow" or "Red" zone results for the Airport Control Tower Cab.

Table 4 SGHAT Analysis Results (No of Minutes Reflections are in SGHAT Zones)

Flight Path	"Operational" ±60° Scenario			"Zero Tilt" Scenario		
	SGHAT "Green" Zone	SGHAT "Yellow" Zone	SGHAT "Red" Zone	SGHAT "Green" Zone	SGHAT "Yellow" Zone	SGHAT "Red" Zone
12L	**0**	**0**	**0**	0	0	0
30R	**0**	**0**	**0**	0	0	0
12R	**0**	**0**	**0**	0	0	0
30L	**0**	**0**	**0**	0	0	0
18	**0**	**0**	**0**	0	0	0
36	**0**	**0**	**0**	5	3116	0
06	**0**	**0**	**0**	0	0	0
24	**0**	**0**	**0**	0	0	0
H	**0**	**0**	**0**	0	0	0
Control Tower	**0**	**0**	**0**	0	0	0

Note 1 the two SGHAT results [X1 , X2] refer to the results for the "West" (X1) and "East" (X2) Panel scenarios respectively

The findings of the results shown in **Table 4** are as follows:

- In normal "Operational" mode, there is NIL Glare potential for Air Traffic Controllers at Tamworth Airport and NIL Glare for Runways 12L/30R, 12R/30L, 06/24 and 18/36, as well as the worst-case helicopter landing and take-off flight paths.
- For the theoretically possible "Zero" Tilt mode, there is potential for "Potential for After-Image" along a worst-case landing path to Runway 36.

Accordingly, under normal "Operational" mode, the above findings meet the SGHAT requirements recommended by the FAA for off-airport Solar PV installations and would therefore present no hazard to air navigation. The potential for "Yellow Zone" SGHAT occurrences along Runway 36 for the "Zero" Tilt scenario suggests that, in any situation where the tilting action of the solar array is disabled, panels should not be left horizontal, but be left tilted to the east, with a minimum tilt angle of 10° or greater, during the months of September to April.

6.2 Motorist "Disability" Glare and Pedestrian 'Discomfort" Glare

The "major" and "minor" thoroughfares in the immediate vicinity of the Project are shown in **Figure 5**, including:

- Oxley Highway – eastbound and westbound "major"
  Werris Creek Road – northbound and southbound "major"
- Country Road – northbound and southbound "minor"
  Maine Drive - northbound and southbound "minor"
  Warral road - northbound and southbound "minor"

The relevant TI criteria for the above roads would be:

- For (Motorist) Traffic Disability Glare, the TI Value should remain below 20 for "minor" roads and below 10 for "major" roads; and
- For Pedestrian Discomfort Glare, the TI Value should remain below 2 at pedestrian crossings and below 3 for other locations.

Important factors influencing the potential for traffic disability glare include:

- Any difference in elevation between the motorist and the solar panel array.
- The potential for solar reflections of concern to be obstructed by intervening terrain and topography as well as any vegetation, trees, etc.
- The difference between the line of sight of a driver (i.e. in the direction of the road) and the line of sight relative to incoming reflections. Significant TI values can only occur when this difference is small. In some cases, eg when traffic is moving away from the line of incoming reflections, such reflections become essentially invisible to the motorist – this would apply for example to traffic on Country Road moving southwards after passing by the site.

Figure 12 shows that some of the potential road glare scenarios for the Project site. In most cases, the difference in line of sight of a driver and the Project (and hence potential reflections) is reasonable, ie not small. Note also the presence of small terrain undulations and vegetation/trees providing line of sight interruption to the site from some roadway locations.

SLR has undertaken TI Value calculations for the roadways discussed above. Calculation locations were varied along the relevant carriageways at positions where the line of sight of drivers was close to the angle of potential incoming solar reflected rays.

The results are shown in **Table 5**, which indicate the following:

- TI Values registered for all carriageways were zero at all times of the year.

In all cases above the relevant Motorist Traffic Disability Glare criteria and Pedestrian Discomfort Glare criteria are satisfied. The reasons for this result are:

- The same elevation for motorists and the solar array panels, with some intervening vegetation and trees in between.
- The single axis trackers which support the panels cause outgoing reflections for all incoming solar angles to be redirected upwards away from the ground.

Table 5 TI Value Results – Combined Results from ALL PROJECT SOLAR PANELS

Location		Classification	TI Value	Occurrence	
				Time of Year / Day	Duration
Oxley Highway	eastbound westbound	Major	**nil**	all-year-round all-year-round	na na
Werris Creek Road	northbound southbound	Major	**nil**	all-year-round all-year-round	na na
Country Road	northbound southbound	Minor	**nil**	all-year-round all-year-round	na na
Maine Drive	northbound southbound	Minor	**nil**	all-year-round all-year-round	na na
Warral Road	northbound southbound	Minor	**nil**	all-year-round all-year-round	na na

Figure 12 View of the Project from Surrounding Roads

Driving south along Country Road



Driving eastwards along Oxley Highway



6.3 Rail Operator Reflective Glare

The nearest operational rail line to the project – refer **Figure 5** - is the Country Regional Line running between Werris Creek (to the southwest) and Tamworth. It is just over 1.8 km to the east-southeast at its closest point.

When passing level with the Project, the line is not aligned in such a way that a train driver (moving either towards Tamworth or towards Werris Creek) would be looking directly towards the Project's solar panels.

Finally, we note that the planned major Inland Rail Link Project will pass well to the west and north of the Project.

Accordingly, there are no disability glare issues relevant to rail operations in the area of the Project.

6.4 Industrial Critical Machinery Operators

There are no industrial operations in the vicinity of the Project (e.g. mining operations) and none planned (mining or otherwise), with the kind of machinery where the relevant operators have the potential to experience reflective glare from the Project, eg elevated cabins in draglines, etc.

6.5 Residential "Nuisance" Glare

The nearest residential receivers to the Project are identified in **Figure 6**.

- They surround the site at distances varying from under 100 m to well over 1 km from the nearest respective Project site boundary; and
- They vary in ground elevation from 385 m (RR6) to425 m (RR4).

There are no formal TI Value (or alternative) criteria governing reflective glare from solar facilities. Accordingly, SLR has carried out TI Value calculations for the receivers discussed above, to gain an understanding of the potential for nuisance glare conditions from the project. The results are shown in **Table 6**.

Table 6 TI Value Results

Receiver (refer Figure 6)	TI Value	Occurrence	
		Time of Year / Day	Duration
RR1, RR2, RR3, RR4, RR5, RR6, RR7, RR8, RR9	**nil**	all-year-round	na

The results indicate that there is no glare potential from the Project to any surrounding residential or sensitive receivers, primarily due to:

- The same elevation for all receivers and the solar array panels and in some cases with intervening trees and vegetation in between.
- The single axis trackers which support the panels cause outgoing reflections for all incoming solar angles to be redirected upwards away from the ground.

6.6 Night-Time Illumination Glare

Although presently not fully defined, it is assumed that an area within the South Tamworth Solar Farm Project site will be set aside for an Operation and Maintenance Building, fire access routes and egress, etc, and that some of these may need to be operational 24/7.

Although night-time illumination is not presently planned for the Project, it may be required in the future for some of the above relevant areas and, as such, is addressed in principle in this assessment.

The only potential for any future night-time illumination glare would be associated with the nearest thoroughfares and residential and other sensitive receivers to the Project. Consideration has also been given to the potential for adverse eco-lighting impacts on nocturnal fauna habitats in close proximity to the Project site, especially within any close-by native vegetation areas. On the basis of the Flora and Fauna Assessment Report carried out for the Project, there are no such habitats close to the Project site.

The recommendations set out below are therefore made in the event that future 24/7 lighting is incorporated into the Project, to achieve the best lighting performance (taking into account safety considerations) while having a minimal impact on the surrounding properties, carriageways and nocturnal fauna.

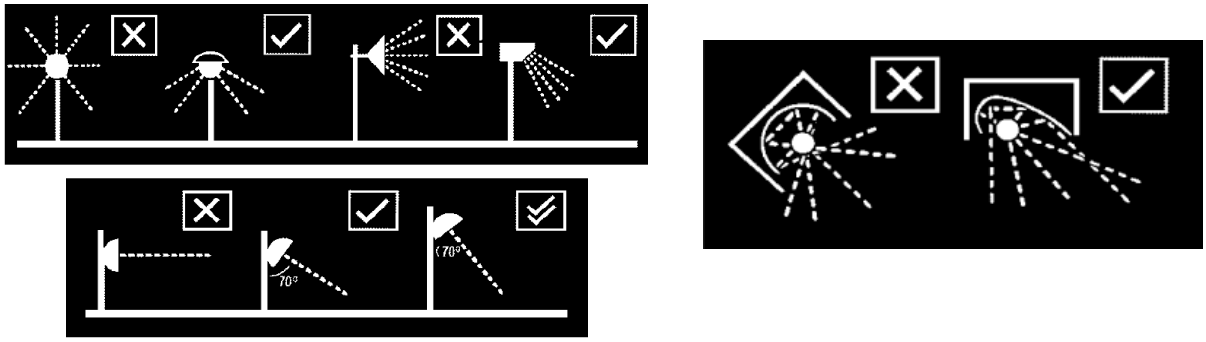
In terms of any future potential night-time lighting, the adopted goal of limiting night-time light spill to no more than 1 lux falling on the nearby residential facades during curfew hours will be easily achieved given the distances to the nearest residential and other receivers.

Accordingly, the potential for any future nuisance glare will be non-existent.

AS4282-1997 Control of the Obtrusive Effect of Outdoor Lighting sets out general principles that should be applied when designing outdoor light to minimise any adverse effect of the light installation.

- Direct lights downward as much as possible and use luminaires that are designed to minimise light spill, e.g. full cut-off luminaires where no light is emitted above the horizontal plane, ideally keeping the main beam angle less than 70°. Less spill-light means that more of the light output can be used to illuminate the area and a lower power output can be used, with corresponding energy consumption benefits, but without reducing the illuminance of the area - refer **Figure 13**.
- Do not waste energy and increase light pollution by over-lighting.
- Wherever possible use floodlights with asymmetric beams that permit the front glazing to be kept at or near parallel to the surface being lit.

Figure 13 Luminaire Design Features that Minimise Light Spill



7 CONCLUSION

SLR Consulting Australia Pty Ltd (SLR) has been engaged by KDC to carry out a Reflective Glare assessment of the proposed South Tamworth Solar Farm (the "Project") under development by Providence Asset Group.

The following potential glare conditions have been considered:

- Daytime Reflective glare (and glint) arising from the solar PV panels within the facility:
  - . Aviation Sector Reflective Glare.
  - . Motorist "Disability" Reflective Glare and Pedestrian "Discomfort" Reflective Glare.
  - . Rail Operator Reflective Glare.
  - . Industrial critical machinery operators (heavy vehicles, etc) Reflective Glare.
  - . Residential "Nuisance" Glare.
- Night-time Illumination glare if any 24/7 operational security lighting is incorporate into the Project in the future.

The Project is located in Westdale, 6 km southwest of Tamworth town centre, NSW. Tamworth Airport is located 3.5 km to the northwest. The proposed (up to) 5 MWac facility will comprise 14,196 solar PV panels within a 13.25 ha project site area. The 425 W panels, measuring 2 m by 1 m, will be positioned as currently understood on single-axis trackers oriented north-south with a spacing of 6 m. At their maximum tilt angle of 60° the height of the panels relative to local ground level is 2.73 m.

Aviation-Related Potential Glare

Quantitative analysis using the FAA-SGHAT software tool has shown that there will be nil glare from the Project for landing flight paths on all of Tamworth Airport's runways (including helicopters) and the airport's Airport Control Tower Cab with the solar array in normal operational mode, ie panels tilting ±60°. To avoid the potential for "Yellow Zone" SGHAT occurrences along Runway 36 for the theoretical "Zero" Tilt scenario, it is recommended that, in any situation where the tilting action of the solar array is disabled, panels should not be left horizontal, but be left tilted to the east, with a minimum tilt angle of 10° or greater, during the months of September to April.

Motorist "Traffic Disability" Glare

Primarily due to the selection of the single-axis tracking system for the mounting of the ground-based array panels, there will be nil glare from the Project in relation to traffic disability glare.

Rail Traffic "Disability" Glare

Given the distance and orientation of the nearest rail line, the potential for related glare is nil.

Residential Nuisance Glare

The potential for nuisance glare from the Project to surrounding residential or other receivers is nil.

Night-Time Illumination Glare

Although presently not incorporated into the Project, consideration has been given to the future potential for night-time lighting related to equipment and/or buildings, fire access routes and egress, etc.

Recommendations have been made to ensure that the potential for any future possible night-time illumination glare will be non-existent.

APPENDIX A

SGHAT Ocular Plots – Tamworth Airport Operations

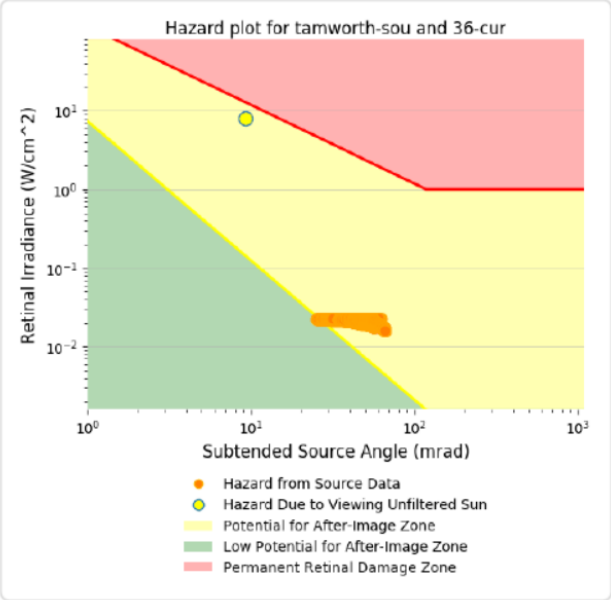
"OPERATIONAL" ±60° MODE (normal mode for the solar array)

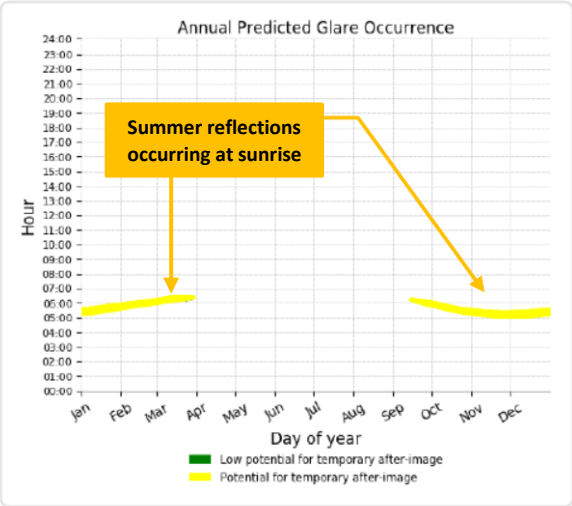
Runway 12L	NIL result
Runway 12R	NIL result
Runway 30L	NIL result
Runway 30R	NIL result
Runway 18	NIL result
Runway 36	NIL result
Runway 06	NIL result
Runway 24	NIL result
Runway Helicopter	NIL result
Airport Control Tower Cab	NIL result

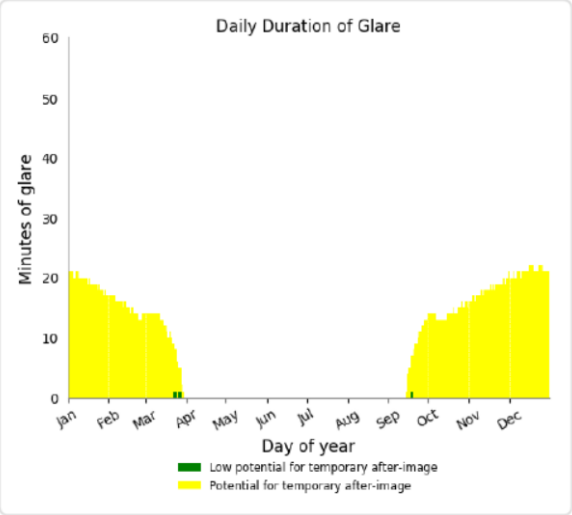
"ZERO" TILT MODE (potential mode during shutdown, maintenance, etc)

Runway 12L	NIL result
Runway 12R	NIL result
Runway 30L	NIL result
Runway 30R	NIL result
Runway 18	NIL result
Runway 36	**see SGHAT Plot**
Runway 06	NIL result
Runway 24	NIL result
Runway Helicopter	NIL result
Airport Control Tower Cab	NIL result

Flight Path 36







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MARA CONSULTING

Social Impact Statement

South Tamworth Solar Farm

Providence Asset Group

8 April 2020

Project Name	
Location	Westdale, NSW
Project Number	2015
Client	Providence Asset Group
Mara Consulting Document	20200408_2015_Mara_Providence_South Tamworth Solar Farm_SIS_003

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1. Introduction

1.1 Overview

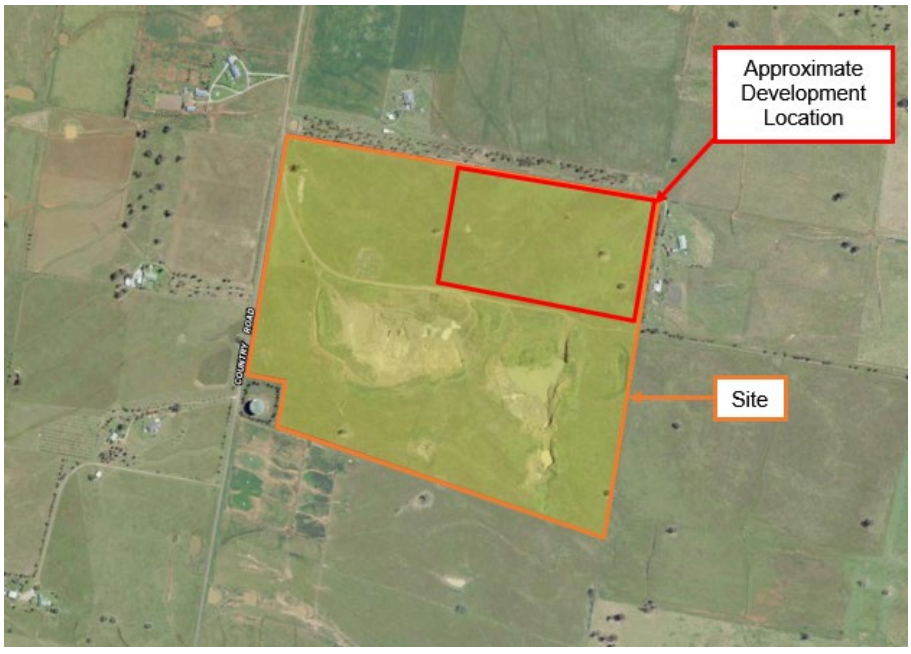
Providence Asset Group (Providence) is seeking development consent from Tamworth Regional Council to develop a solar farm at Lot 211 DP1069964, Country Road, Westdale NSW 2340 (refer to Figure 1).

The site is located on the eastern side of Country Road, within the Tamworth Regional Council Local Government Area (LGA). The surrounding area is made up of large rural lots generally containing a rural type land use typically with a single dwelling house. The Tamworth Airport is located approximately 3.5 km to the north west of the site.

Mara Consulting (Mara) has been engaged by KDC Planners to undertake a Social Impact Statement (SIS) for the proposal. This SIS includes consideration of:

- the social baseline of Westdale State Suburb (SSC), as well as the wider Tamworth Regional LGA
- assessment of the likely social impacts of the proposed development based on the scale, intensity and duration of the potential impacts.
- proposed mitigation and enhancement strategies of impacts that may have a potentially significant impact on the community.
- conclusions and recommendations that arise from the assessment in relation to the project.

Figure 1 The proposed site



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1.2 Project description

The solar farm project at Westdale includes a grid-connected solar photovoltaic (PV) installation, which will operate at no more than 5MW. It is proposed to connect into the electrical transmission grip via the existing transmission lines which run along the northern and eastern boundary of the site. The network connection configuration remains subject to Essential Energy's connection application process.

The solar farm will include the following components:

- 14,196 x 425w solar PV panel
- 204 x single axis solar trackers
- 2 x 2,500kVA inverters
- 1 x medium voltage power station unit.

A 4m wide access road is proposed connecting the solar farm to the approved access to Country Road at the western area of the lot. The solar farm will be fully fenced with a gate for access on the western boundary. A car park area, off load area and temporary construction office are indicatively located on the Development Plan.

1.3 Regulatory context

The proposed solar farm is defined as 'electricity generating works' which is a permissible form of development in accordance with the State Environmental Planning Policy (Infrastructure) 2007.

The site is zoned RU4 Primary Production Small Lots under the Tamworth Regional Local Environmental Plan 2010 (LEP 2010).

The proposed development is private infrastructure with a capital investment value (CIV) greater than $5 million and as a result the development is deemed to be regionally significant development and the application will be referred to the Joint Regional Planning Panel (JRPP) for determination.

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2. Existing environment

2.1 Community and social baseline

The project is located within the State Suburb of Westdale (SSC), within the Tamworth Regional Local Government Area (LGA) in the southern area of North West Region of NSW.

Tamworth is a regional city that provides one in three of the region's homes and jobs and a variety of high-level services, including civic, entertainment and cultural venues. These include Tamworth Base Hospital, TAFE NSW and national sporting facilities like the Australian Equine and Livestock Events Centre. The balance of the urban population lives in surrounding smaller settlements including Manilla, Kootingal, Barraba, Nundle and Moonbi.[1]

Tamworth's strong agricultural foundations in industries such as poultry, beef cattle and cropping, are well serviced by rail, road and air networks. The manufacturing industry, retail and commercial services, aviation and tourism are also important economic generators. The Tamworth Country Music Festival attracts more than 50,000 festival goers each year. [2]

Westdale is located to the west of the Tamworth Central Business District and is bounded by the Peel River in the north and the locality of West Tamworth in the east.[3] According to the Tamworth Regional Council Economic Profile (June 2019), Westdale –Taminda has an estimated population of 2,894 (2019) and is expected to have a gradual growth over the coming years, with a forecasted population of 3,117 in 2021. Population projections indicate that the population of Tamworth Regional is estimated to increase by 7,900 people between 2016 and 2041, from 61,000 to 68,900.[4]

A social baseline of Westdale SSC and the Tamworth LGA was developed to provide context for the assessment of potential impacts on the community as a result of the project. Key demographics are shown in Table 1 and summarised below. The state of NSW has also been shown in the assessment for comparative purposes.

At the 2016 census[5], there were 895 dwellings in the Westdale SSC with the majority occupied (92.7%). The median weekly rent for the suburb is $325, which is much lower when compared to the NSW median of $380. At $1,517 per week, median mortgage repayments in the suburb were also much lower than the state average ($1986).

The median weekly household income for the suburb is comparable with the NSW median ($1,410 compared to $1,486) with 60 per cent of homes being owned (either outright or with a mortgage). More homes are rented in the suburb compared to the state average (37.1% and 31.8% respectively).

[1] https://www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/New-England-North-West/New-England-North-West-Regional-Plan/Local-Government-Narratives
[2] https://www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/New-England-North-West/New-England-North-West-Regional-Plan/Local-Government-Narratives
[3] https://profile.id.com.au/tamworth/about?WebID=240
[4] http://economy.id.com.au/tamworth
[5] https://quickstats.censusdata.abs.gov.au/census_services/getproduct/census/2016/quickstat/SSC14259?opendocument

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The unemployment rate in Westdale is comparable to the wider Tamworth LGA (5.4% and 5.8%), both of which are lower than the state average (6.3%).

The most common occupations of residents in Westdale are labourers (17.7%), technicians and trade workers (17%) and professionals (13.7%). This is consistent with the most common occupations in the Tamworth LGA - professionals (17.5%), technicians and trades workers (14.4%), and labourers (14.1%).

In Westdale SSC and Tamworth LGA, most of the population was born in Australia (83.7% and 84.6% respectively) and primarily only spoke English at home (86.8% and 88.7%). This shows that the communities residing in the LGA are not necessarily as culturally and linguistically diverse (CALD) when compared to the state average, where 26.5 per cent of the population speaks a language other than English at home.

At the 2016 census, there were 59,663 people in the Tamworth LGA, of these 48.7 per cent were male and 51.3 per cent were female. Aboriginal and Torres Strait Islander people made up 10.1 per cent of the population, which was greater than three times higher than the NSW average of 2.9 per cent.

There are a large number of working age people in Westdale, with the median age being 29 years old, approximately a decade younger than Tamworth LGA (40 years) and the NSW state average (38 years). A relatively large portion of the Westdale population are in the 25-29 years, 30-34 years and 35-39 years age groups (7.9%, 9.1% and 8.3% of the population). However, there is also a relatively high representation of the 0-4 years and 5-9 years age groupings, with 20.5 per cent of the population within this range. This is reflective of the number of young families residing in the area (both coupled families and single parent). Those aged over 65 years make up only 7.1 per cent of the population.

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Table 1 Socio-economic overview of Westdale SSC, Tamworth LGA and NSW (ABS 2016)

Statistic	Westdale SSC	Tamworth LGA	NSW
Population	2,755	59,633	7,480,228
Median age (years)	29	40	38
Top three industries of employment (%)	Labourer (17.7), Technians and Trades Workers (17), Professionals (13.7)	Hospitals (5.3), Secondary Education (3), Supermarket and Grocery Stores (2.5)	Health Care and Social Assistance (12.5) Retail Trade (9.7) Education and Training (8.4)
Largest occupation of employment (%)	Meat Processing (5.4), Supermarket and Grocery Stores (4.3), Defence (4.0)	Professionals (17.5), Technicians and Trades Workers (14.4), Labourer (14.1)	Professionals (23.6), Clerical and Administrative Workers (13.8), Managers (13.5)
Unemployed (%)	5.4	5.8	6.3
Median weekly household income ($)	1410	753	1486
Couple family without children (%)	29.1	40.7	36.6
Couple family with children (%)	47.5	38.8	45.7
Tenure – owned (%)	16	33.9	32.2
Tenure – mortgage (%)	43.9	31.1	32.3
Tenure – rented (%)	37.1	30.9	31.8
Occupied private dwellings (%)	92.7	89.4	90.1
Travel to work – one method (largest %)	Car, as driver (71)	Car, as driver (70.7)	Car, as driver 57.8
Marital status (married %)	45.9	47.6	48.7
Born overseas (%)	16.3	15.4	34.5
English only spoken at home	86.8	88.7	68.5
Households where a non-English language is spoken (%)	7.5	4.6	26.5
Aboriginal and Torres Strait Islander (%)	15	10.1	2.9
Volunteering (%)	14.8	21.8	18.1

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The project area is under the Tamworth Regional LGA and Council planning is guided by the 'The Community Strategic Plan 2017 – 2027'.[6] This is the major strategic document developed to guide the delivery of services and facilities over the next decade and outlines the goals of the elected council. The plan has the following vision:

"A region of opportunity and prosperity, a place to call home"

The Plan identifies five key themes that bring together what the community has asked for and the priorities for the region. These themes include a spirit of community, a prosperous region, an accessible region, a region for the future and a region of progressive leadership and include a strategy to 'encourage efficient use of resources to improve environmental sustainability' (Tamworth Regional Council, 2017).

The New England North West Regional Plan 2036[7] describes one of the key goals for the region as becoming a strong and dynamic regional economy and identifies growing New England North West as a renewable energy hub. One of the key goals is to deliver:

"A diversified economy through the management of mineral and energy resources, including renewable energy generation"

Establishing solar farms in the region aligns with Council's strategic planning and the direction of the New England North West Regional Plan.

[6] https://www.tamworth.nsw.gov.au/about/policies-plans-and-regulations/community-strategic-plan
[7] https://www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/New-England-North-West/Plan

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3. Potential positive and negative impacts

3.1 Community attitudes to renewable energy

Outcomes of community research commissioned in 2015 by the former NSW Office of Environment and Heritage regarding attitudes to renewable energy found that generally, solar energy developments enjoy community support.[8]

The research found that 89 per cent of people support the use of renewable energy in the form of solar farms in NSW and that 78 per cent of respondents supported having a solar farm within 1-2 km of where they lived. Among the reasons for this were benefits to the environment and local economy.

Specific to the North West Region:

- 94 per cent of respondents supported using renewables to generate electricity in NSW
- 81 per cent believed NSW should increase the use of renewables over the next five years
- 95 per cent supported the use of solar farms in NSW, 92 per cent in their local region, and 84 per cent within 1–2 kilometres of where they lived.

The most common perceived advantages of renewables (unprompted) included environmental benefits and lower cost of electricity. The most common perceived disadvantages (unprompted) included higher cost and concerns about efficiency and reliability. In the North West, 74 per cent were prepared to use renewables 'provided I don't have to pay more for my electricity' and 22 per cent were prepared to pay more to support them.

3.2 Access to renewable energy

Electricity consumption in Australia is exceptionally high, resulting in costly electricity bills and frequent disruptions to electricity supply during peak times. The renewable energy sector has responded to this high demand and to the need for viable alternative options for electricity generation contributing to 17 per cent of Australia's overall electricity.[9]

An analysis of electricity price increases between 2006 and 2016 was undertaken by the Australian National University (ANU). The ANU reported that those states with relatively low levels renewable energy experienced higher electricity prices (NSW, QLD and VIC). States with higher levels of renewable energy, in particular South Australia which generated almost half of its energy from renewables, had a far lower electricity price.[10]

[8] https://www.environment.nsw.gov.au/resources/actionmatters/community-attitudes-renewable-energy-150419.pdf

[9] https://assets.cleanenergycouncil.org.au/documents/resources/reports/CEC-briefing-paper-Australias-clean-energy-investment-outlook-September-2019.pdf

[10] https://assets.cleanenergycouncil.org.au/documents/resources/reports/CEC-briefing-paper-Australias-clean-energy-investment-outlook-September-2019.pdf

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The solar farm's potential to generate 5MW of electricity with the potential to power 2,000 homes during daylight hours and reduce CO2 emissions by about 200,000 tonnes over the 25-year life of the project. Due to the changing nature of government incentive schemes for renewable energy generation, the solar farm has been developed so it is not reliant on these schemes for profitability.

3.3 Population

Due to the nature of the development, there is not an expected population change associated with the site either temporarily in the construction of the development or permanently once the development is complete.

3.4 Social amenity (noise, dust and visual impacts)

The impact of the project on social amenity, including those related to noise, dust and visual impacts are key issues to consider in relation to both construction and operation of the proposed solar farm.

The potential for noise during construction and operation are primarily key issues for near neighbours with noise affecting their quality and duration of sleep and their way of life. An assessment of noise and associated impacts has been undertaken as part of the development application.[11] The assessment found that construction noise levels have potential to exceed relevant construction noise management levels at two receiver locations. The assessment recommends mitigation measures to minimise the potential noise impacts from construction, albeit of a temporary nature during the daytime over a six-month construction period. In regard to operational and road noise, the assessment found that noise criteria would be satisfied.

Given the outcomes of the assessment, the project should implement an effective noise management plan for construction and consult with nearby receivers to minimise the potential impact on nearest receivers. Assuming adequate construction management is implemented, the potential impact for noise on the surrounding community is considered low.

Visual amenity in terms of glare and reflectivity and changes to the visual landscape can be perceived issues of the community in relation to the potential impacts of solar farms. Furthermore, landholders may be potentially concerned about the time it would take for vegetation screens to establish, whether they would be tall enough to screen the panels and whether they would be watered and maintained.

The site of this proposal is located approximately 1.6 km south of Gunnedah Road, along the Eastern side of Country Road. The landscape surrounding the site is predominantly agricultural land dominated by grazing paddocks. There are occasional residential/farm houses with associated structures. The closest residential communities are approximately 1.8 km to the east and north.[12]

[11] Muller Acoustic Consulting, South Tamworth Solar Farm, Noise Assessment 2020
[12] Mara Consulting, South Tamworth Solar Farm Visual Impact Assessment 2020

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A visual impact and reflective glare assessment for the project have been conducted and assessed the likely visual impacts of the proposal (including any glare, reflectivity and night lighting) on surrounding residences and other potentially impacted stakeholders.

The visual impact assessment found that in the immediate vicinity of the proposal (<1.5km), the proposal would likely have a high visual impact from the buildings and residences immediately to the north (one property) and east (two properties), primarily due to the close proximity. The rectilinear forms and rigid linear arrangement of the solar panels also contrast with the surrounding natural forms. This visual impact can be mitigated by introducing new trees and screen planting along northern and eastern boundaries. From a distance of between 1.5 – 3 km the proposed development is most visible with a low to medium visual impact. While the site is visible to a larger number of viewers, most of these views are screened and partially obstructed.

The project has a minimal visual impact from distances greater than 3 km.[13]

The reflective glare assessment found that the potential for adverse glare from the proposed facility will be negligible. This is primarily due to the selection of the single-axis tracking system for the mounting of the ground-based array panels and the distances to nearest receivers of interest in relation to aviation, road traffic, rail traffic and residential. The visual impact assessment noted that in terms of glare, given the parameters of reflection and the movement of the solar panels, there are no locations surrounding the site where glint or glare are geometrically possible.[14]

In terms of air quality, the nuisance of dust on stakeholder's way of life and amenity, are primarily experienced during construction. A construction management plan should be developed to mitigate potential impacts.

It should be noted that the area is still considered to be drought affected, despite recent rainfall. Given that water is generally a mitigation measure used to control dust, this could result in a negative social impact. The use of water during drought should be minimised and other innovative methods for controlling dust should be considered.

3.5 Personal and property rights

In Bathurst, NSW, a community is opposing a proposed Solar Farm with one of the identified fears being that the facility will lead to a drop-in land values.[15]

A similar concern is also reflected in the Environmental Impact Statement for the Tamworth Solar Farm and the potential impact of the development on the visual amenity and what affect that might have on the property values. Landholders expressed concerns about the time it would take for vegetation screens to establish, whether they would be tall enough to screen the panels and whether they would

[13] Mara Consulting, South Tamworth Solar Farm Visual Impact Assessment 2020
[14] SLR Consulting, South Tamworth Solar Farm Reflective Glare Assessment 2020
[15] Western Advocate (2017), Brewongle Solar Farm: Opposition from residents. Accessed March 2020 at https://www.westernadvocate.com.au/story/4920308/solar-plant-will-lead-to-property-value-drop-real-estate-agent/

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be watered and maintained. If landholders wanted or needed to sell in the near future, the rate of establishment of the vegetation screens might influence the selling price and the likelihood of sale. [16]

Outcomes of community research commissioned in 2015 by the former NSW Office of Environment and Heritage regarding attitudes to renewable energy identified that Property values identified that a small number of survey respondents raised concerns about decreased land/house values and often mentioned this in conjunction with the visual impact they perceived local wind and solar farms would have ('Could be ugly and decrease land value'; 'Visual impact - impact on property prices arising from that visual impact'). [17]

There is insufficient sales data to provide a definitive answer to the question of whether solar farm development in NSW impacts on surrounding land values, however, the size and scale of the proposal lends itself to mitigating potential risks and designing the proposal to prevent, minimize and/or offset adverse environmental impacts and impacts on the community.

3.6 Land use history and management

An Aboriginal Archaeological Assessment has been undertaken[18] and states that:

"The previous land use history indicates that the project area has been subject to heavy land degradation, which is highly likely to have impacted the retention of any remnant or later topsoils. The combination of farming and quarrying in the project area renders the preservation of intact Aboriginal sites and material culture unlikely."

This notwithstanding, the assessment makes recommendations for undertakings to ensure any artefacts that may be discovered are dealt with appropriately.

Solar farms have the potential to impact on neighbouring agricultural operations including impacts on grazing livestock and cropping from the spread of weeds from the project site and soil and groundwater contamination.

Provisions have been made within the proposal to allow the site to potentially double up as pastureland for grazing. With the implementation of adequate management plans and ensuring that the trackers are of appropriate height to allow for grazing, it is not considered that the project would significantly impact the agricultural operations of neighbouring landholders given the relatively low impacts associated with the solar farm.

A flood impact assessment for the proposal has been undertaken. This assessment indicates that the flood impacts of the proposed solar farm development are minor and localised and are not considered to adversely affect neighbouring properties or connecting roads.

[16] ProjectE (2020), Environmental Impact Statement, Tamworth Solar Farm
[17] https://www.environment.nsw.gov.au/resources/actionmatters/community-attitudes-renewable-energy-150419.pdf
[18] VIRTUSHERITAGE,Tamworth Quarry Solar Project Due Diligence Aboriginal Archaeological Assessment 2020

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3.7 Traffic impacts

While the project is unlikely to result in any changes to population, due to additional workforce requirements during construction there is the potential for traffic associated with the Project to affect the way of life of near neighbours, local business and community members. These impacts relate to disruption associated with additional traffic movements and the potential changes to accesses.

A traffic assessment has been carried out and notes that, overall, the proposal will not adversely impact on the efficiency and effectiveness of the local and state road network during construction or operation. As such, the impact on traffic from a social perspective is considered low.[19]

3.8 Local economy and employment opportunities

Construction of the proposal is expected to take up to 6 months and involve a workforce of up to 30 people.

The top occupation of employment in the area is labourers (17.7%); therefore, the construction of the development would have the potential to increase employment opportunities of locals for the period of construction only.

It is also plausible that existing businesses proximal to the development experience higher rates of business as a flow on effect during construction. To enhance the positive impact employment opportunities will have on the community, it is recommended that local contractors be used for any construction needs.

Given there would be no permanent staff on site during operations, the potential positive benefit on the economy in terms of employment opportunities is considered negligible.

3.9 Intergenerational equity

Consideration of intergenerational equity is an emerging key theme in project development processes. Primarily, concerns relate to environmental impacts, including climate change and the costs to future generations. In the context of the Proposal, notions of Intergenerational Equity can relate to the rehabilitation of land to facilitate future land use, and broader climatic issues regionally and internationally.

A flora and fauna study has been undertaken with the biodiversity impacts of the project assessed in accordance with the NSW Biodiversity Assessment Method (BAM). The assessment concludes that the removal of native vegetation will be limited to groundcover and isolated mature trees. However, they are not considered to be important habitat for the long-term survival of threatened species within the locality. No other significant impacts are considered likely. The assessment suggests avoidance and mitigation measures to reduce any potential impacts.[20]

[19] Intersect Traffic, Traffic Impact Assessment 2020
[20] Kleinfelder, Flora and Fauna Assessment Report 2020

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In terms of climate change, greenhouse gas and energy the construction and operation of the South Tamworth Solar Farm proposal would contribute to Australia's efforts to meet its greenhouse gas commitments while continuing to provide a reliable supply of electricity for industry and consumers. Specifically, it would provide the following benefits:

- directly contribute to helping Australia in meeting the Renewable Energy Target
- reduce greenhouse gas emissions required to meet Australia's international climate conditions
- assist in the transition towards cleaner electricity generation.

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4. Conclusion and Recommendations

Overall, it is considered that the development:

- is consistent with the regulatory and business development framework, including state government legislation and the Tamworth Regional Council strategic plans (summarised in Section 2)
- will have positive impacts on intergenerational equity, with the provision of cleaner energy in the future
- supports Commonwealth and NSW climate change commitments
- will generate enough clean, renewable energy for about 2,000 homes
- is an appropriate development in relation to the projected changes to population and demographics in the region
- is unlikely to have significant negative social impacts to the locality and region
- would be a benefit contributing to the overall community sustainability of the Tamworth community.

In order to maximise the social benefits anticipated through the development it is recommended that:

- liaison with local industry representatives to maximise the use of local contractors, manufacturing facilities, materials
- establish visual screening early to minimise the visual impact on the solar farm. Visual screening should be done in consultation with closest property holders in accordance with Visual Impact Assessment and Landscaping Plan
- establish good relations with people living in the vicinity of the proposal site at the beginning of the proposal and maintain
- implement a community consultation plan to manage impacts to community stakeholders, including but not limited to:
    - mitigation measures to reduce potential construction impacts
    - protocols to keep the community updated about the progress of the Proposal and proposal benefits
    - protocols to inform relevant stakeholders of potential impacts (haulage, noise, air quality etc.)
    - protocols to respond to any complaints received
    - information on how potential customers can access the renewable energy source
    - a process to monitor the predicted social impacts and amend mitigation and management measures as required*.

* Providence contacted neighbouring properties to inform them of the proposal via a letterbox drop, face-to-face meetings and phone calls. They also held a meeting with Tamworth Regional Council

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MARA CONSULTING



TRAFFIC IMPACT ASSESSMENT

SOLAR PHOTOVOLTAIC (PV) POWER GENERATING FARM & ASSOCIATED SUPPORTIVE INFRASTRUCTURE

PART LOT 211 DP 1069964 COUNTRY ROAD, WESTDALE

PREPARED FOR: PROVIDENCE ASSET GROUP

APRIL 2020

20/023

TRAFFIC IMPACT ASSESSMENT
PROVIDENCE ASSET GROUP

SOLAR PHOTVOLTAIC (PV) POWER FARM
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COUNTRY ROAD, WESTDALE

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QUALITY ASSURANCE

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	25/03/20	Draft	JG
B	26/03/20	Traffic Data / Edit	JG
C	02/04/20	Final Proof	JG
D	02/04/20	Approved	JG

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This document has been authorised by

Date 2nd April 2020

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1.0 INTRODUCTION

Intersect Traffic Pty Ltd (Intersect Traffic) has been engaged by KDC Pty Ltd on behalf of Providence Asset Group to prepare a traffic impact assessment report for a proposed Solar Photovoltaic (PV) Power Farm (up to 5MW) on part of Lot 211 DP 1069964 – Country Road, Westdale.

The proposed development involves installation of solar panel banks, off-load area, inverter and AC combiner area, HV switchboard area, MV power station area, direct connection to a suitable existing power line in the south-east corner of the site, on-site car parking and temporary construction office. Vehicular access to the site will be via a new access road with turnaround area off Country Road to the west of the site. In the future this access will be shared with a proposed Rural Fire Service Control Centre also to be constructed on the site adjacent to the Solar Farm. The development concept plans are shown in ***Attachment A.***

This report is required to support a development application to Tamworth Regional 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 western side of Country Road, Westdale approximately 1,7 km south of the Oxley Highway, 3.7 km south-east of Tamworth Airport and approximately 6 kilometres south-west of the Tamworth CBD. The site currently contains a quarry that is not within the development area which will continue operating post development of the Solar Farm.

The property has the formal title of Lot 211 in DP 1069964, Country Road, Westdale and the development area for the proposal is approximately 13.25 hectares. The site is currently zoned RU4 – Primary Production Small Lots pursuant to the Tamworth Regional LEP (2010).

The existing main vehicular access to the site is currently provided at Country Road via a recently constructed rural access crossing to the existing quarry located approximately 50 metres south of the proposed new vehicular access off Country Road to the Solar Farm through the proposed new NSW Rural Fire Service development access. Deliveries to the site will use the identified delivery road shown on ***Figure 1*** being via the Oxley Highway and New England Highway from the south from Sydney and Newcastle. Noting Country Road is not a designated B-Double route, Council will need to provide special permission for B-Doubles to deliver materials to the site. It is considered that Country Road is suitable for use by B-Double vehicles. ***Photograph 1*** below shows the existing development site from Country Road while ***Photograph 2*** shows the existing recently constructed vehicular access to the quarry on the site.

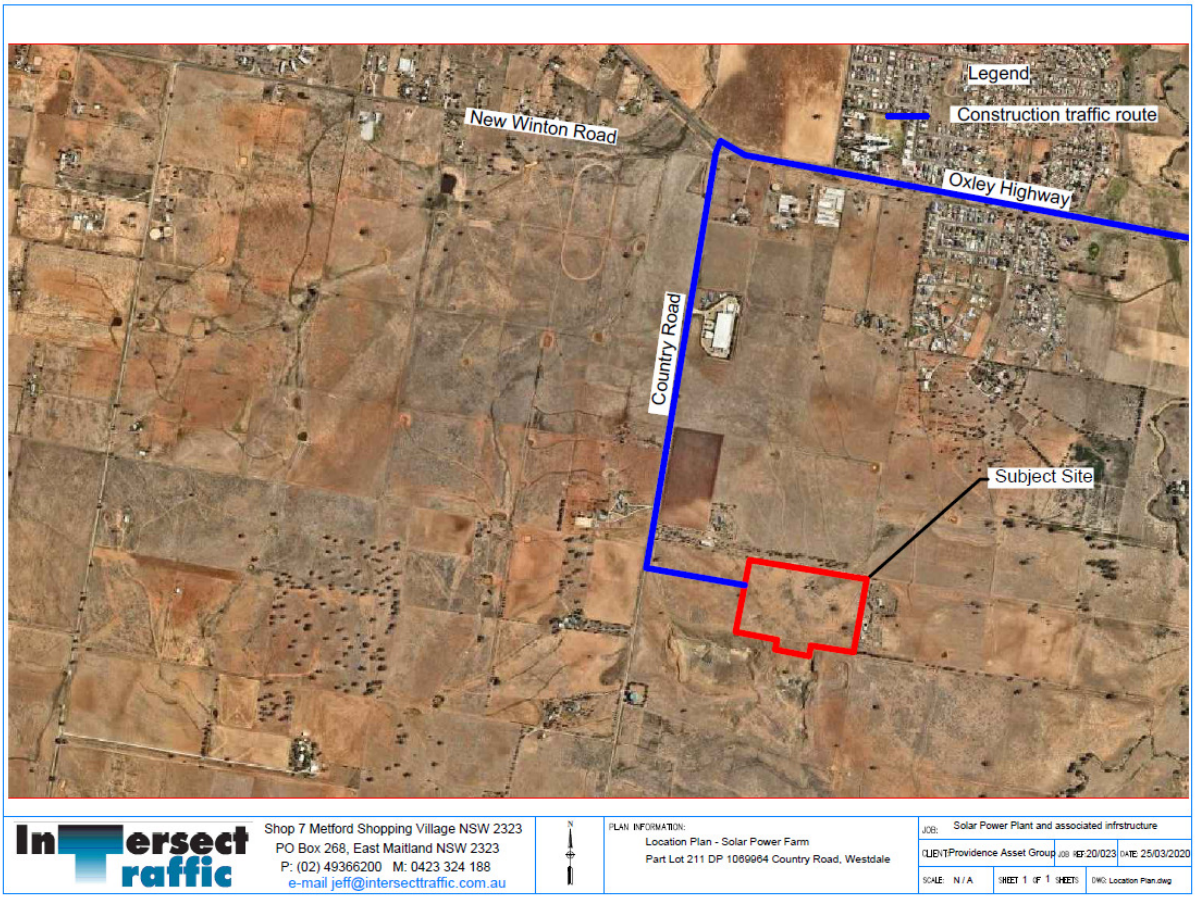


Figure 1 – Site Location



Photograph 1 – Development site



Photograph 2 – Existing vehicular access to site (Quarry) off Country Road.

3.0 EXISTING ROAD NETWORK

3.1 Oxley Highway

The Oxley Highway is a classified state highway (A39) with its primary function to connect the mid-north coast of NSW (Port Macquarie, Wauchope) to the New England area (Walcha, Tamworth, Gunnedah) to the Central West of NSW (Coonabarabran, Gilgandra and Warren). As such it is an arterial road and major NSW transport route from inland NSW to the NSW coastal area. As a sealed rural arterial road the Oxley Highway is under the care and control of NSW Roads and Maritime Services (RMS) or Transport for NSW (TfNSW) as they are now known.

Near Westdale the Oxley Highway is a two-lane two-way sealed rural road with an 8-metre wide sealed carriageway consisting of 3.5 metre wide travel lanes and 0.5 metre wide sealed shoulders. Additional turning lanes are provided at major intersections along its length, including at the Country Road intersection. Near the site the speed zoning is 70 km/h however a variable speed school zone exists immediately east of Country Road along the Westdale Public School frontage. This reduces the speed zoning to 40 km/h during peak drop off and pick up times for students. At the time of inspection the Oxley Highway was observed to be in good condition as shown in ***Photograph 3*** below.



Photograph 3 – Oxley Highway, Westdale.

3.2 Country Road

Country Road is a local rural road with its primary function to provide vehicular access to properties along its length though it also performs a collector road function in distributing the local traffic to the arterial road network at the Oxley Highway. As a local road it is under the care and control of Tamworth Regional Council and a 70 km/h speed zoning would also apply to Country Road. Note Country Road is not a designated B-Double route.

Country Road is a two lane two sealed road with a sealed pavement width of 7 metres with variable width gravel road shoulders and table drains. This allows two lanes of traffic flow, one in each direction but provides little parking or pull over areas along its length. It currently services an industrial food processing facility and a quarry therefore already has a higher than normal percentage of heavy vehicle traffic. Country Road is only centreline and edge line marked near its intersection with the Oxley Highway. At the time of inspection the sealed pavement of Country Road was in excellent condition as shown in ***Photograph 4*** below however a relatively new section of the road past the proposed site access had experienced some shoulder damage from stormwater flows associated with a recent storm which was being repaired (see ***Photograph 5***).



Photograph 4 – Country Road, Westdale near Oxley Highway.



Photograph 5 – Damaged section of Country Road near site access

4.0 ALTERNATE TRANSPORT MODES

Tamworth Buslines runs public transport (bus) services within Tamworth including Route 437 to Westdale as shown in the route map extract in ***Figure 2***. These run approximately hourly on Monday to Friday between 8 am and 6 pm as well as providing 4 AM and 1 PM service on Saturdays. The morning and afternoon services run slightly different routes. This service provides access to the Tamworth CBD with connections to bus services for all other Tamworth service routes. The nearest bus stop is within Westdale at the intersection of the Oxley Highway and Mayne Drive some 2.8 km north-east of the site. This service would not be convenient for construction employees associated with the development.

As a rural area there are no pedestrian footpaths or on / off road cycleways within the local road network. Near the site pedestrians are generally required to utilise the grass verges and road shoulders / pavement while cyclists are required to utilise the road shoulders or share the travel lanes with other vehicles.

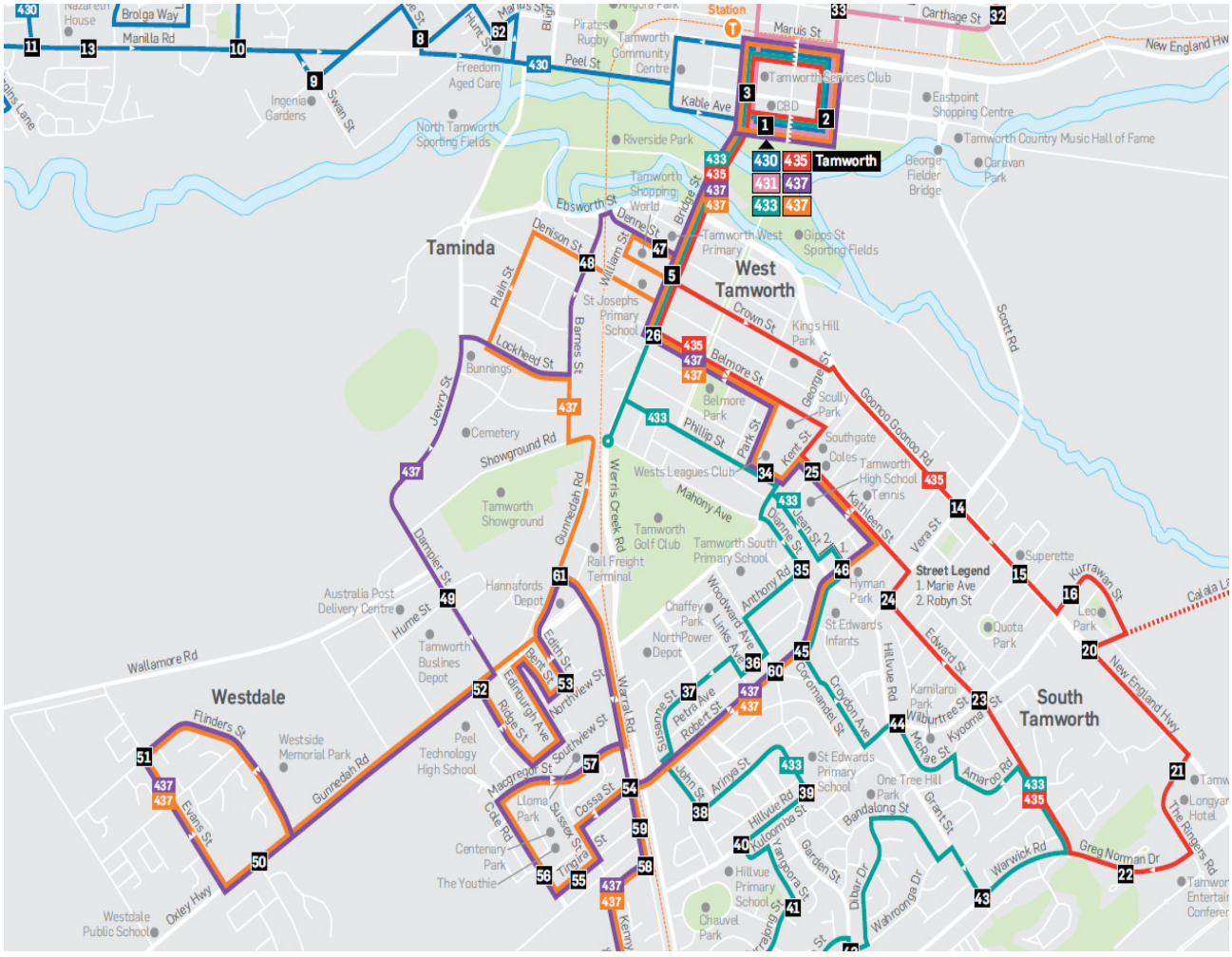


Figure 2 – Tamworth Buslines – Bus Route Map extract

5.0 DEVELOPMENT PROPOSAL

The proposed development involves the construction of a Solar Photovoltaic (PV) 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 roads.
- Installation of inverters, transformers and switchgear.
- Construction of unsealed access road from the proposed NSW Rural Fire Service development access and site.
- Construction of security fence and entrance gate; and
- Drainage and landscaping to Tamworth Regional 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 Friday and 8 am – 1 pm on Saturdays. 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 RMS 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 in ***Attachment C***.

- 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 the 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

Based on this advice 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 all east towards Tamworth with deliveries being via the New England Highway from the south originating from either Newcastle or Sydney. In accessing the site the likely transportation route as envisaged is shown on the location plan (***Figure 1***) in this report.

Existing traffic volumes in the area were recorded by Intersect Traffic at the Oxley Highway / Country Road intersection during the likely peak AM and PM traffic periods (road network) i.e. 8 am – 9 am and 3.00 pm – 4.00 pm on Tuesday 17th March 2020 and Wednesday 18th March 2020 respectively. These periods were chosen following interrogation of NSW RMS data in the area on its Traffic Volume Viewer application. Northern Transport Planning and Engineering also installed a traffic classifier on the Oxley Highway immediately east of Country Road from Tuesday 10th March 2020 until Monday 16th March 2020. The data sheets for these counts are provided in ***Attachment B***.

These traffic counts determined that the relevant peak hour two-way mid-block traffic volumes on the state and local road network in the AM and PM periods during this period were.

- Oxley Highway east of Country Road - 473 vtph in the AM peak and 728 vtph in the PM peak. These are taken from the traffic classifier counts.
- Oxley Highway west of Country Road – 387 vtph in the AM peak and 507 vtph in the PM peak.
- Country Road south of the Oxley Highway – 27 vtph in the AM peak and 25 vtph in the PM peak.

It was noted that the traffic classifier count recorded mid-block traffic volumes on the Oxley Highway east of Country Road 20 % higher in the AM peak and 27% higher in the PM peak than the manual intersection count. This indicates a large variation in daily peak hour traffic and to account for this the manual intersection count data has been increased by 20 % (AM) and 27 % (PM) for the other two legs of the intersection. Therefore the peak AM and PM traffic volumes for the road network adopted in this assessment are as follows.

- Oxley Highway east of Country Road - 473 vtph in the AM peak and 728 vtph in the PM peak.
- Oxley Highway west of Country Road – 460 vtph in the AM peak and 640 vtph in the PM peak.
- Country Road south of the Oxley Highway – 33 vtph in the AM peak and 32 vtph 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 vtph there is no need to do a 2030 (10 year horizon period) assessment of this development.

6.2 – Road Capacity

Table 4.3 of the RMS publication "*RTA's Guide to Traffic Generating Developments"* provides some guidance on likely mid-block capacity of two-lane two-way urban roads. This table is reproduced below as ***Table 1***:

Table 1 – Urban Road Mid-Block Capacity Table

Table 4.3
Typical mid-block capacities for urban roads with interrupted flow

Type of Road	One-Way Mid-block Lane Capacity (pcu/hr)	
Median or inner lane:	Divided Road	1,000
	Undivided Road	900
Outer or kerb lane:	With Adjacent Parking Lane	900
	Clearway Conditions	900
	Occasional Parked Cars	600
4 lane undivided:	Occasional Parked Cars	1,500
	Clearway Conditions	1,800
4 lane divided:	Clearway Conditions	1,900

Source: - RTA's Guide to Traffic Generating Developments (2002)

This table indicates the one-way mid-block capacity of a single travel lane on an undivided urban road is 900 vtph therefore the two-way mid-block capacity of a two-way urban road is twice this value i.e. 1,800 vtph. Therefore the technical two-way mid-block capacity of the local and state road network is 1,800 vtph.

However when considering the local road network i.e. Country Road it is more appropriate to apply the environmental capacity guidelines set by NSW RMS in Figure 4.6 of its "*RTA's Guide to Traffic Generating Developments"* document given the standard of construction of these roads and their primary function of providing access to properties / dwellings along their length. This figure is reproduced below as ***Table 2***.

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)

As a local street Country Road should have traffic volumes less than 300 vtph to maintain an acceptable level of residential amenity within these roads.

Therefore the road capacity thresholds adopted in this assessment are as follows.

- Oxley Highway – 1,800 vtph.
- Country Road – 300 vtph.

As 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 expected to be well below the existing capacity thresholds determined above then 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 vtph 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 mid-block efficiency.

6.3 – Intersection Capacity

The main intersection impacted by the construction of the development is the Oxley Highway / Country Road priority controlled give way T-intersection. To determine the impact of the development on this intersection it has been modelled using the SIDRA INTERSECTION 8 software. SIDRA INTERSECTION is a micro-analytical program which identifies "Level of Service" (LoS) criteria for intersection analysis which range from LoS A to LoS F. Assessment is then based on the LoS requirements of the TfNSW shown below in ***Table 3***:

Table 3 – TfNSW Intersection performance criteria.

Table 4.2
Level of service criteria for intersections

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	< 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control mode	At capacity, requires other control mode

Source: - RTA's Guide to Traffic Generating Developments (2002).

In undertaking this assessment the following assumptions were made.

- The intersection is to remain as currently constructed as an AUR/AUL rural type intersection.
- Traffic data used was sourced by Intersect Traffic in March 2020 with a sensitivity analysis of up to 125 % undertaken to account for the variations in daily traffic peaks identified in the traffic counts.
- Construction traffic used the traffic route identified in ***Figure 1*** with only 4 outbound trips in the AM peak which is mirrored in the PM peak: and
- As the construction period is only 6 months future traffic modelling (i.e.2030) is not required.

The results of the modelling are summarised for the all vehicles case with worst delay and level of service within ***Table 4*** below while the full Sidra movement summary tables are provided in ***Attachment D.***

Table 4 – Oxley Highway / Country Road, Westdale intersection – Sidra Results Summary

Model	Deg. Satn (v/c)	Worst Average Delay (s)	Worst Level of Service	95 % back of queue length (cars)
2020 AM	0.100	9.1	A	0.1
2020 PM	0.160	10.9	A	0.1
2020 AM + construction traffic	0.100	9.3	A	0.1
2020 PM + construction traffic	0.160	11.2	A	0.2
2020 AM + construction traffic - sensitivity	0.124	10.6	A	0.1
2020 PM + construction traffic - sensitivity	0.198	13.6	A	0.3

The modelling shows that even with the additional construction traffic from the Solar Farm the intersection continues to operate satisfactorily in 2020 with the degree of saturation, average delays and level of service well within the acceptable guidelines set by TfNSW. Based on these results it would also be reasonable to conclude the construction traffic would not adversely impact on intersections on the wider road network given the high level of intersection control i.e. roundabouts and traffic signals that exist at the major intersections of the transportation route along the New England Highway and Oxley Highway.

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.

6.4 Access Assessment

In terms of width, the access to the development providing access to a user class 1 (long term) car parking facility with less than 25 car spaces fronting a local road is required to be a category 1 access (Table 3.1 of the Standard). 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 Country Road will need to be a minimum 12.5 metres wide to cater for the swept turning paths for delivery vehicles during the 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 Country Road was observed to be in excess of 300 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 (97 metres desirable for 70 km/h*) as well as Austroads *Guide to Road Design – Part 4A – Unsignalised and signalised intersections - Table 3.2 (151 metres for 70 km/h)* for safe intersection sight distance.

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. In this regard it is noted that Country Road has a sealed pavement a minimum 7 metres wide therefore complies with Austroads Standards for Rural Roads with more than 500 vtph. It would therefore allow two heavy vehicles to pass each other at reasonable speed. Therefore it is considered the proposed transportation route to the site is suitable to carry heavy vehicles and thus is suitable to cater for the construction traffic from the Solar Farm construction. This is further evidenced by the existing heavy vehicle traffic on the road accessing the Baiada site and the adjoining Quarry. However, the additional heavy vehicle loading from the construction may accelerate the deterioration in the sealed pavement along the transportation route. It is therefore recommended that a dilapidation report be prepared for the

project in regard to Country Road in consultation with Tamworth Regional Council to identify unsatisfactory pavement damage caused by the construction of the Solar Farm and ensure the road network is repaired to Council's satisfaction post the construction stage of the development. This will require pre and post construction stage inspections of the road pavement along the proposed transport routes.

Overall with a suitable condition of consent included for the preparation of a dilapidation report covering Country Road and the satisfactory repair of the local road network post construction it is considered the local and state road network would be 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 and Appendix A of the Tamworth Regional Council DCP (2010). 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 m^2 or 1 space per 2 employees whichever is greater.*

With only 1 employee engaged in the day to day operation of the Solar Farm the development is only required to provide 1 on-site car parking space under the DCP requirements. However it is the responsibility of the applicant to also provide sufficient on-site car parking for construction employees during the duration of the construction of the development for the development to comply with the car parking objectives of the DCP. Construction employee car parking will be provided on the hard stand area identified as the construction lay down area and this is large enough to cater for the expected storage requirements during construction as well as th provision of at least 10 on-site car parks for construction employees which is the expected traffic generation from employees to the site as well as being in excess of the Industrial land use requirements of the Tamworth Regional Council DCP (2010). 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 Tamworth Regional Council DCP (2010).

The employee car parking area would need to comply with the requirements of Australian Standard *AS2890.1-2004 Parking Facilities – Part 1 Off-street car parking* with parking bay sizes 2.4 m x 5.4 m and aisle widths of 5.8 metres. There is sufficient room on-site to ensure compliance with this requirement which could be covered by a suitable condition of consent. Overall it is considered suitable on-site car parking can be provided for the development ensuring all vehicle movements to and from the site off Country 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 particularly given the site is not currently serviced by convenient public transport. 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 during both the construction and operation phases of the development 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 Photovoltaic (PV) Power Farm (up to 5MW) on part of Lot 211 DP 1069964 – Country Road, Westdale 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 vtph 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 1,800 vtph for the Oxley Highway (LoS C) as well as the environmental capacity of 200 vtph for the local road network (Country Road). Traffic volumes will remain below these thresholds during the construction and operation of the development.
- The Oxley Highway / Country Road intersection will continue to operate satisfactorily during and post construction of the Solar Farm with little if any impact on the operation of the intersection resulting from the development.
- It is also reasonable to conclude the development will not adversely impact on the intersections on the wider state road network given the high levels of intersection control on the major intersections.
- 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.
- With a suitable condition of consent included for the preparation of a dilapidation report covering Country Road and the satisfactory repair of the local road network post construction it is considered the local and state road network would be suitable to cater for the expected construction traffic associated with the development.
- 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.

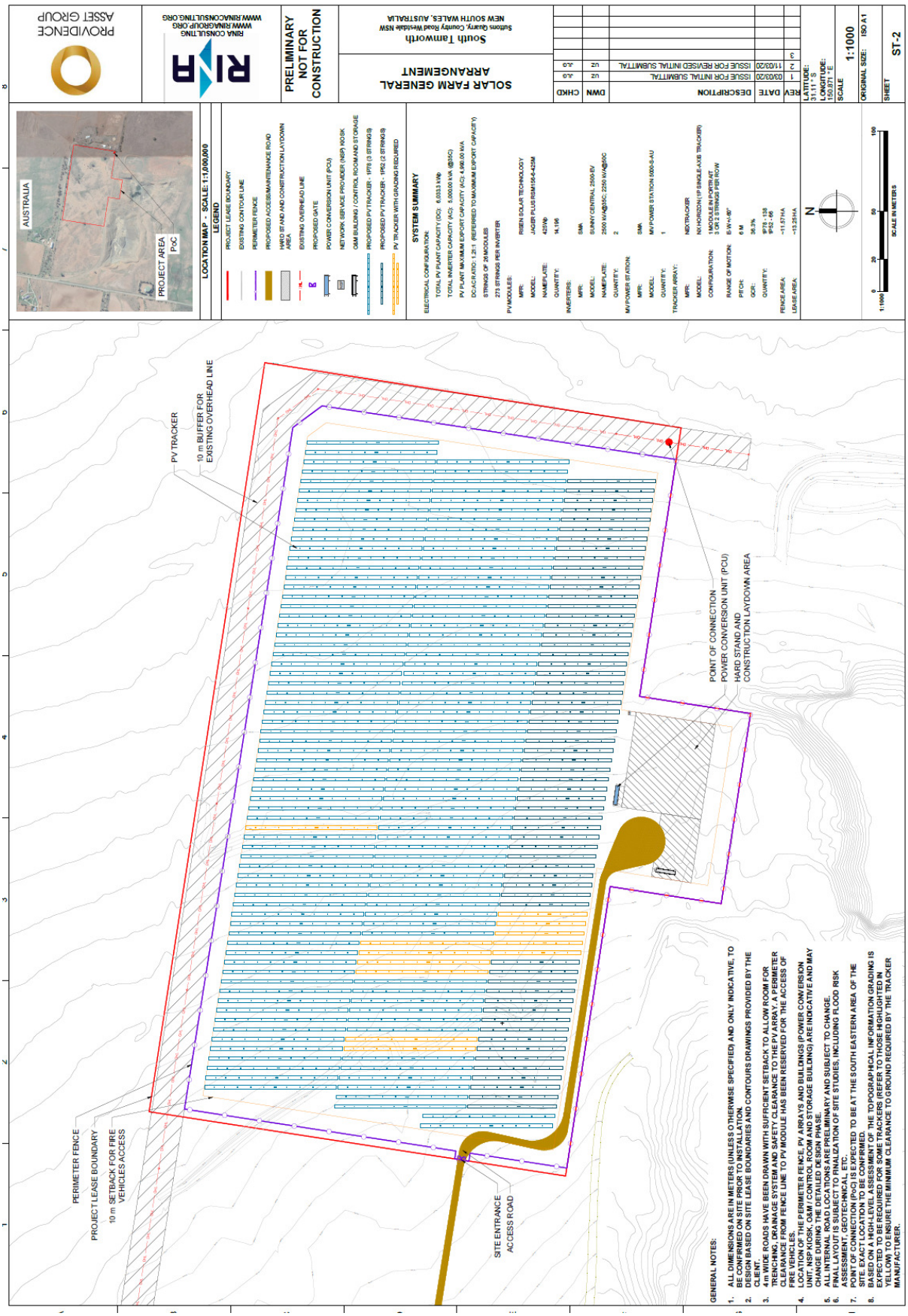
10.0 RECOMMENDATION

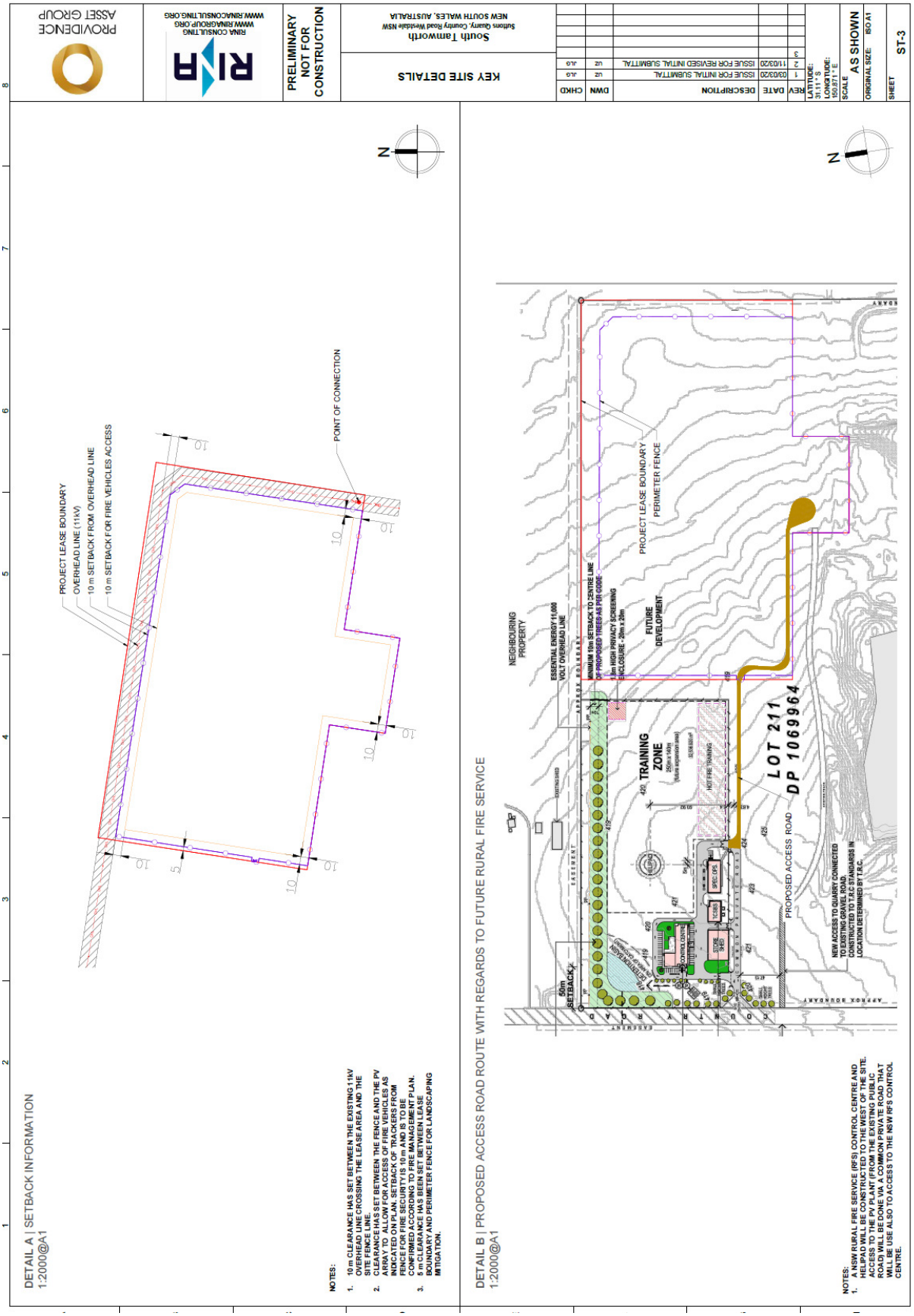
Having carried out this traffic and parking assessment for the proposed Solar Photovoltaic (PV) Power Farm (up to 5MW) on part of Lot 211 DP 1069964 – Country Road, Westdale it is recommended that the proposal can be supported from a traffic perspective as the development will not adversely impact on the local road network and complies with all relevant requirements of Tamworth Regional Council, Austroads, Australian Standards and NSW RMS.

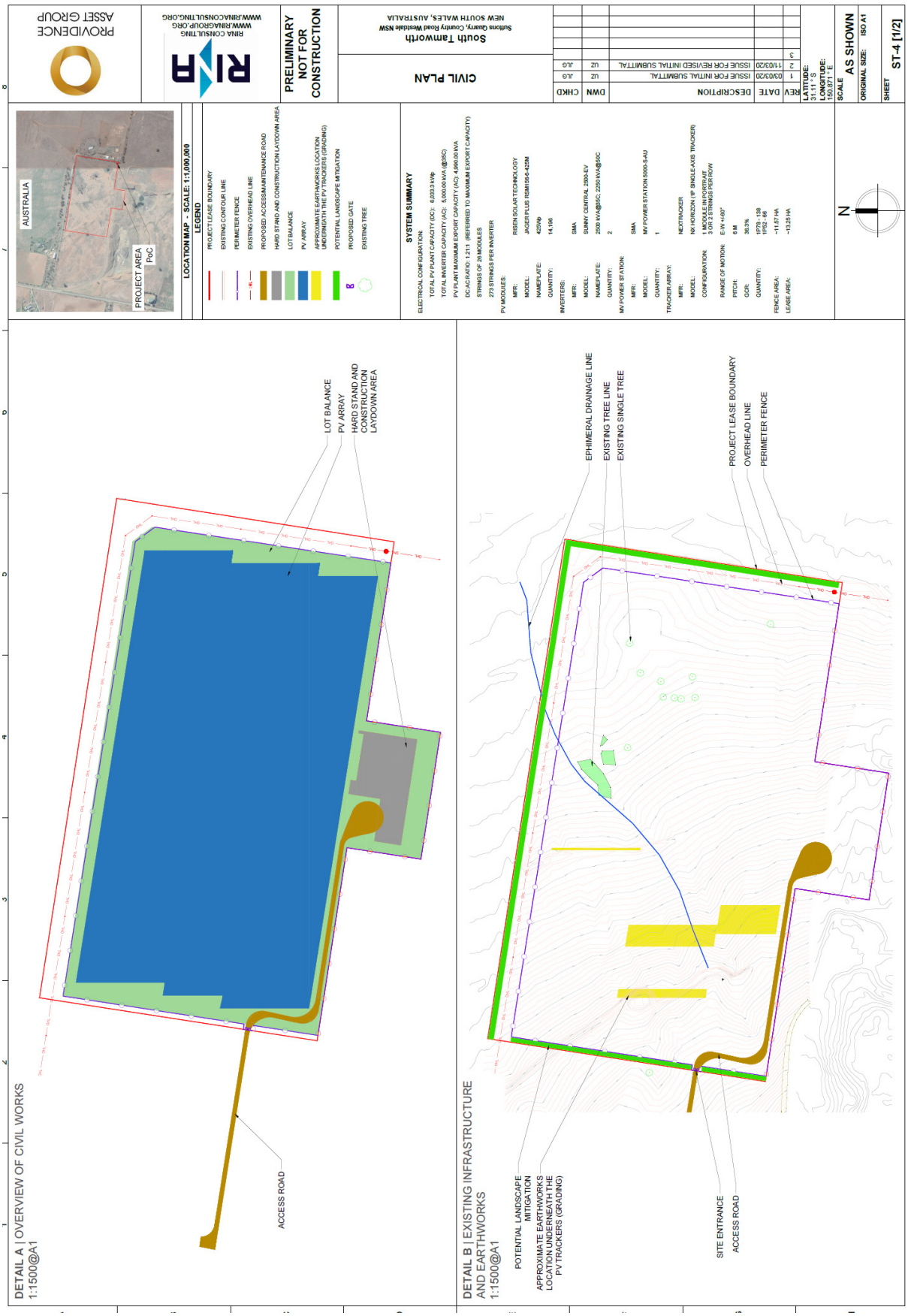


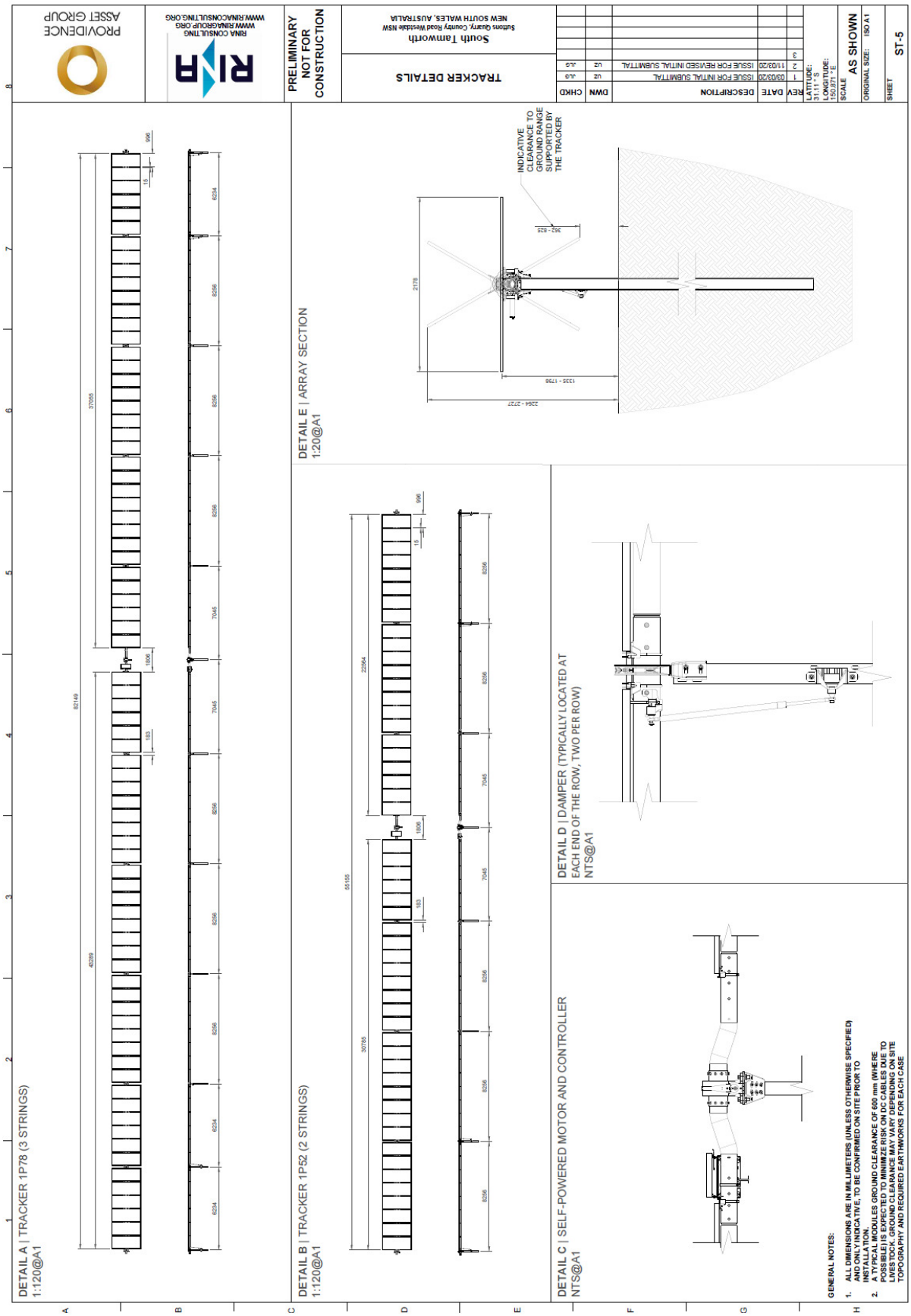
JR Garry BE (Civil), Masters of Traffic
Director
Intersect Traffic Pty Ltd

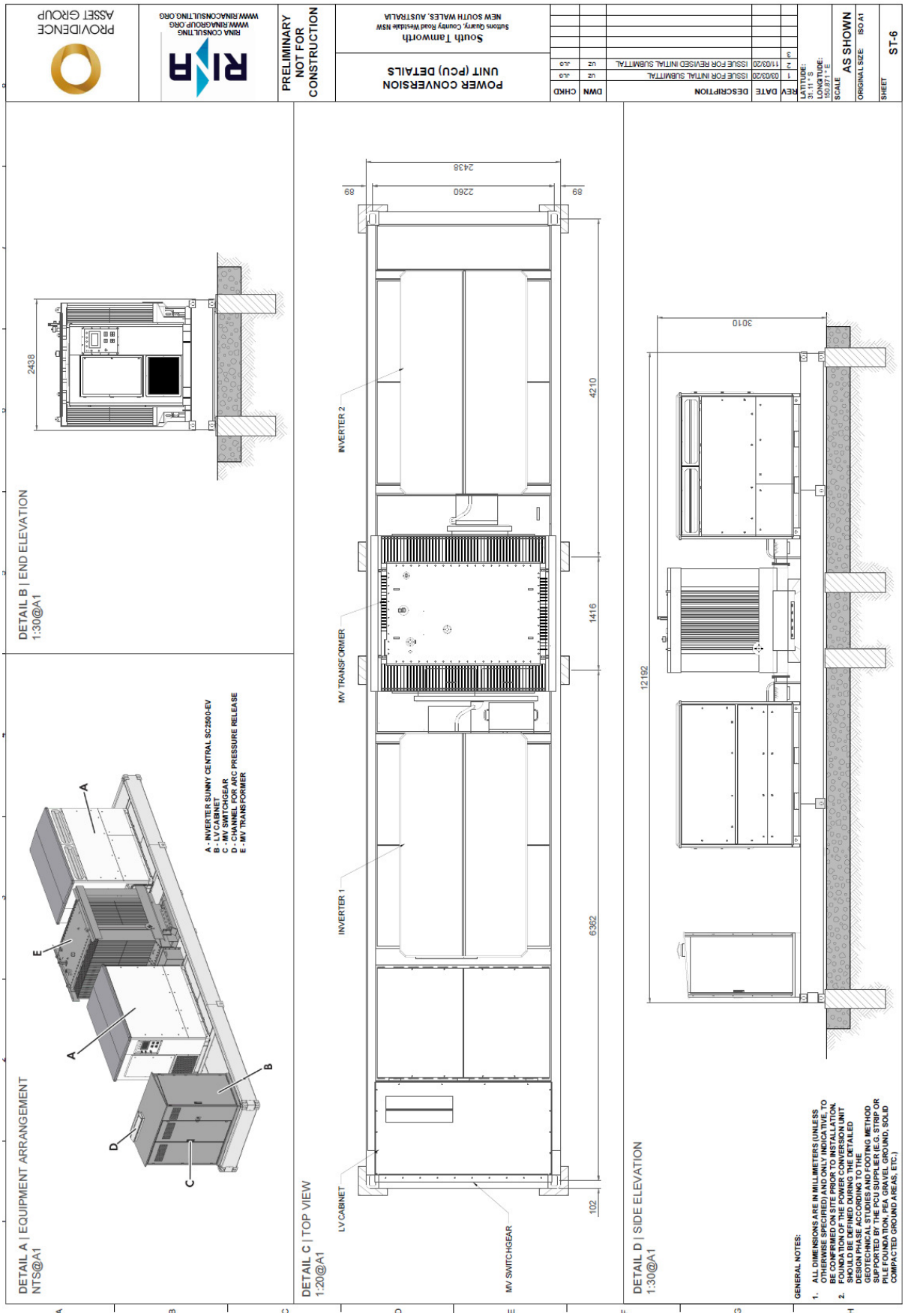
ATTACHMENT A
DEVELOPMENT PLANS

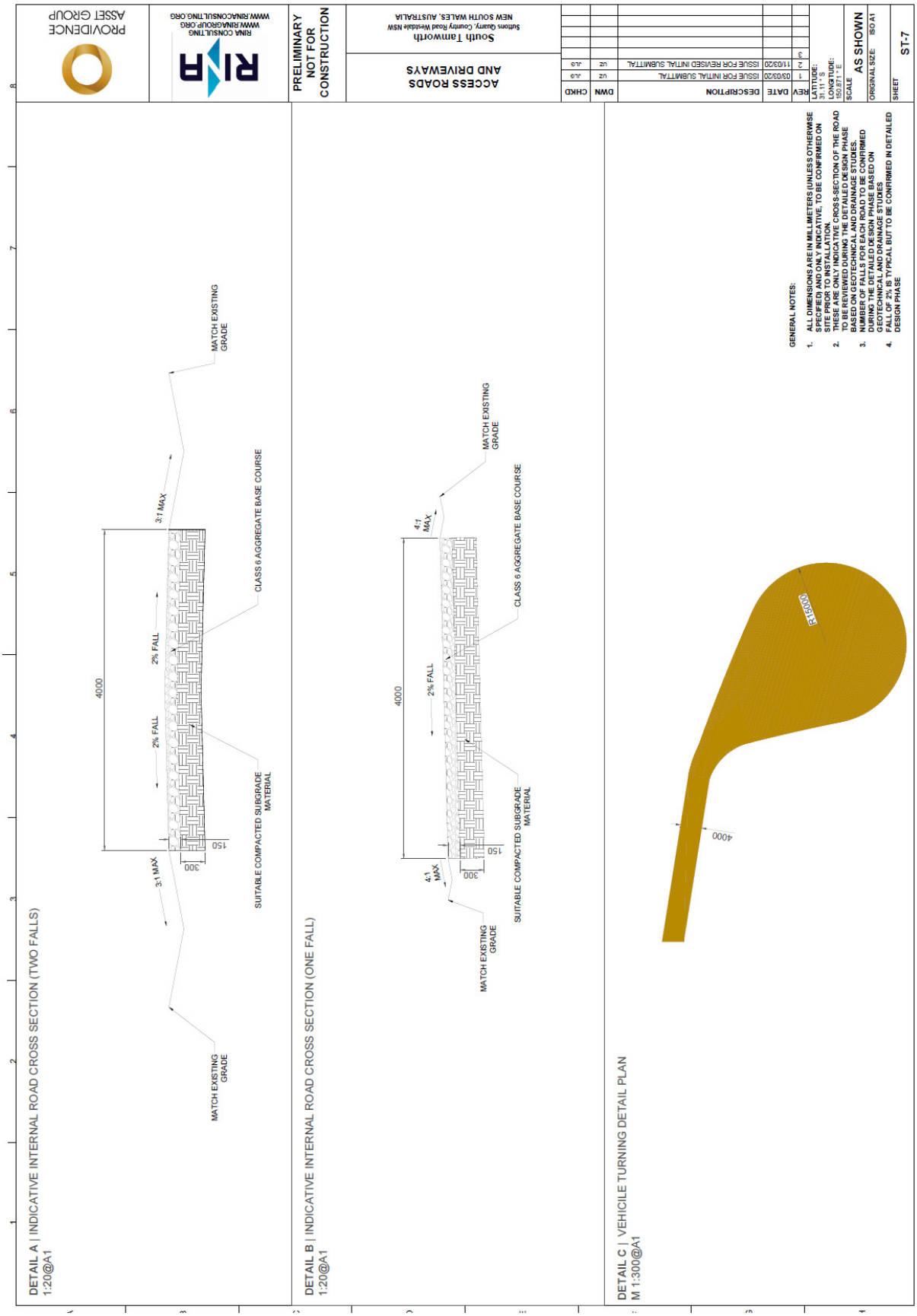

PROVIDENCE ASSET GROUP
RIA CONSULTING
WWW.RIAGROUP.ORG
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PRELIMINARY NOT FOR CONSTRUCTION
SOLAR FARM GENERAL ARRANGEMENT
South Tamworth
Sutton Quarry, Country Road Westdale NSW
NEW SOUTH WALES, AUSTRALIA
DESCRIPTION
ISSUE FOR INITIAL SUBMITTAL
ISSUE FOR REVISED INITIAL SUBMITTAL
LATITUDE: 31°11'1"S
LONGITUDE: 150.871°E
SCALE 1:1000
ORIGINAL SIZE: ISO A1
SHEET ST-2
LOCATION MAP - SCALE: 1:10,000
AUSTRALIA
PROJECT AREA
PoC
LEGEND
PROJECT LEASE BOUNDARY
EXISTING CONTOUR LINE
PERIMETER FENCE
PROPOSED ACCESS/MAINTENANCE ROAD
HARD STAND AND CONSTRUCTION LAYDOWN AREA
EXISTING OVERHEAD LINE
PROPOSED GATE
POWER CONVERSION UNIT (PCU)
NETWORK SERVICE PROVIDER (NSP) KIOSK
O&M BUILDING / CONTROL ROOM AND STORAGE
PROPOSED PV TRACKER - 1PTE (3 STRINGS)
PROPOSED PV TRACKER - 1PS2 (2 STRINGS)
PV TRACKER WITH GRADING REQUIRED
SYSTEM SUMMARY
ELECTRICAL CONFIGURATION:
TOTAL PV PLANT CAPACITY (DC): 6.0533 kVp
TOTAL INVERTER CAPACITY (AC): 5.000/00 kVA @35C)
PV PLANT MAXIMUM EXPORT CAPACITY (AC): 4,986.00 kVA
DC:AC RATIO: 1.20:1 (REFERRED TO MAXIMUM EXPORT CAPACITY)
STRINGS OF 30 MODULES
273 STRINGS PER INVERTER
PV MODULES:
MFR: RISEN SOLAR TECHNOLOGY
MODEL: JAGER PLUS RSM156-6-425M
NAMEPLATE: 425Wp
QUANTITY: 14,196
INVERTERS:
MFR: SMA
MODEL: SUNNY CENTRAL 2500-EV
NAMEPLATE: 2500 kVA@35C; 2250 kVA@50C
QUANTITY: 2
MV POWER STATION:
MFR: SMA
MODEL: MV POWER STATION 5000-S-AU
QUANTITY: 1
TRACKER ARRAY:
MFR: NEXTRACKER
MODEL: NX HORIZON (1P SINGLE-AXIS TRACKER)
CONFIGURATION: 1 MODULE IN PORTRAIT 30 MODULE STRINGS PER ROW
RANGE OF MOTION: ± 60°
PITCH: 6 M
GCR: 36.3%
QUANTITY: 273 - 1SS 952 - 1PS
FENCE AREA: ~11.57 HA
LEASE AREA: ~15.25 HA
N
SCALE IN METERS
0 20 50 100
1:1000
PV TRACKER
10 m BUFFER FOR EXISTING OVERHEAD LINE
POINT OF CONNECTION
POWER CONVERSION UNIT (PCU)
HARD STAND AND CONSTRUCTION LAYDOWN AREA
PERIMETER FENCE
PROJECT LEASE BOUNDARY
10 m SETBACK FOR FIRE VEHICLES ACCESS
SITE ENTRANCE ACCESS ROAD
GENERAL NOTES:
1. ALL DIMENSIONS ARE IN METERS (UNLESS OTHERWISE SPECIFIED) AND ONLY INDICATIVE, TO BE CONFIRMED ON SITE PRIOR TO INSTALLATION.
2. DESIGN IS BASED ON SITE LEASE BOUNDARIES AND CONTOURS DRAWINGS PROVIDED BY THE CLIENT.
3. 4 m WIDE ROADS HAVE BEEN DRAWN WITH SUFFICIENT SETBACK TO ALLOW ROOM FOR TRENCHING, DRAINAGE SYSTEM AND SAFETY CLEARANCE TO THE PV ARRAY. A PERIMETER CLEARANCE FROM FENCE LINE TO PV MODULE HAS BEEN RESERVED FOR THE ACCESS OF FIRE VEHICLES.
4. LOCATION OF THE PERIMETER FENCE, PV ARRAYS AND BUILDINGS (POWER CONVERSION UNIT, NSP KIOSK, O&M / CONTROL ROOM AND STORAGE BUILDING) ARE INDICATIVE AND MAY CHANGE DURING THE DETAILED DESIGN PHASE.
5. ALL INTERNAL ROAD LOCATIONS ARE PRELIMINARY AND SUBJECT TO CHANGE.
6. FINAL LAYOUT IS SUBJECT TO FINALIZATION OF SITE STUDIES, INCLUDING FLOOD RISK ASSESSMENT, GEOTECHNICAL INVESTIGATION, ETC.
7. POINT OF CONNECTION (POC) IS EXPECTED TO BE AT THE SOUTH EASTERN AREA OF THE SITE. EXACT LOCATION TO BE CONFIRMED.
8. BASED ON A HIGH-LEVEL ASSESSMENT OF THE TOPOGRAPHICAL INFORMATION GRADING IS EXPECTED TO BE REQUIRED FOR SOME TRACKERS (REFER TO THOSE HIGHLIGHTED IN YELLOW) TO ENSURE THE MINIMUM CLEARANCE TO GROUND REQUIRED BY THE TRACKER MANUFACTURER.

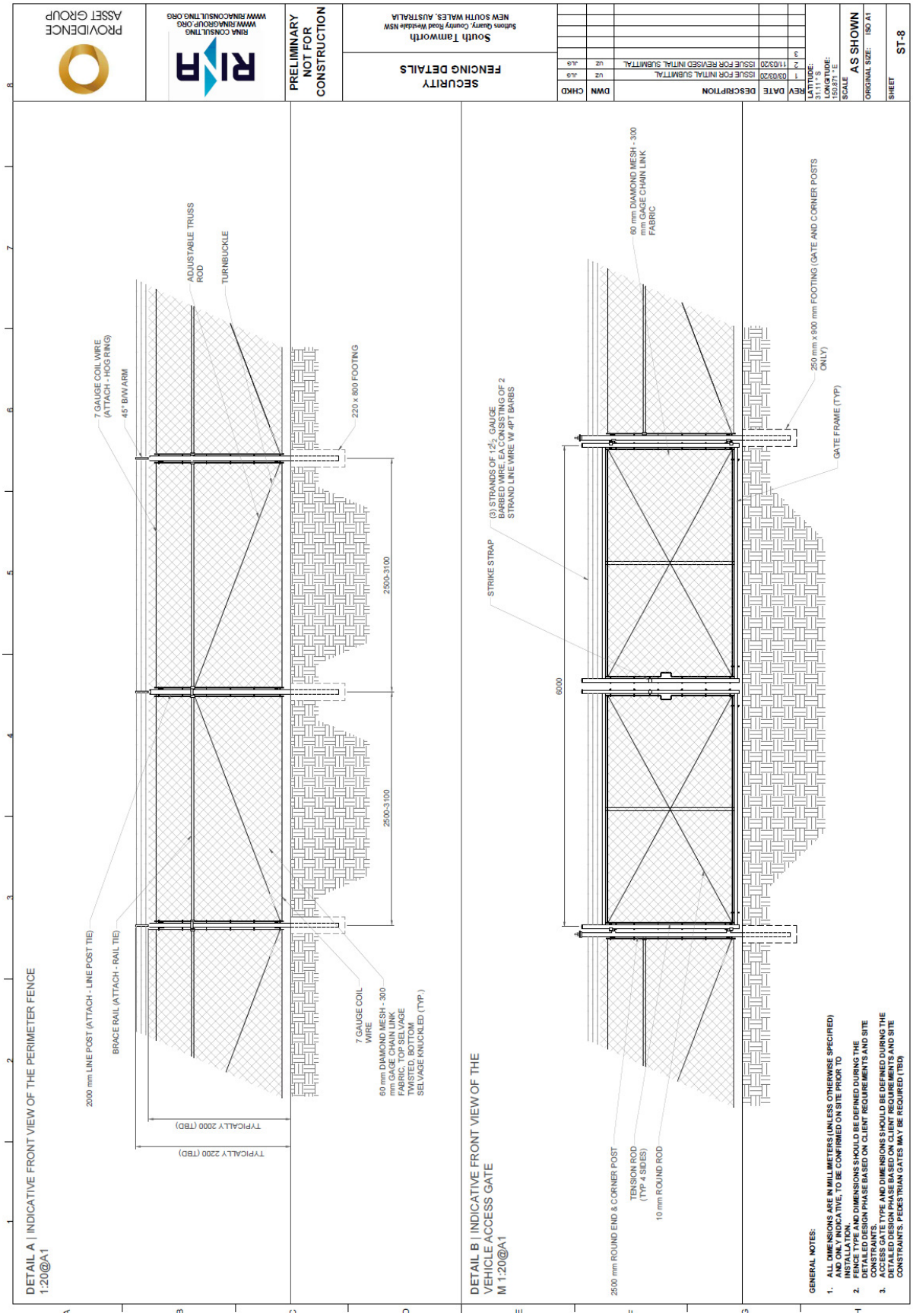

PROVIDENCE ASSET GROUP
RIAC CONSULTING
WWW.RIACONSULTING.ORG
WWW.RIACGROUP.ORG
PRELIMINARY NOT FOR CONSTRUCTION
KEY SITE DETAILS
South Tamworth
Sutton Quarry, Country Road Westdale NSW
NEW SOUTH WALES, AUSTRALIA
REV DATE DESCRIPTION DWN CHKD
1 03/03/20 ISSUE FOR INITIAL SUBMITTAL LC JLG
2 11/03/20 ISSUE FOR REVISED INITIAL SUBMITTAL LC JLG
3
LATITUDE: 33° 11' 35
LONGITUDE: 150.971 ° E
SCALE AS SHOWN
ORIGINAL SIZE: ISO A1
SHEET ST-3
N
PROJECT LEASE BOUNDARY
OVERHEAD LINE (11kV)
10 m SETBACK FROM OVERHEAD LINE
10 m SETBACK FOR FIRE VEHICLES ACCESS
POINT OF CONNECTION
10
5
DETAIL A | SETBACK INFORMATION
1:2000@A1
NOTES:
1. 10 m CLEARANCE HAS SET BETWEEN THE EXISTING 11kV OVERHEAD LINE CROSSING THE LEASE AREA AND THE SITE FENCE LINE.
2. CLEARANCE HAS SET BETWEEN THE FENCE AND THE PV ARRAY TO ALLOW FOR ACCESS OF FIRE VEHICLES AS INDICATED FOR ASSET PROTECTION ZONES. FROM FENCE FOR FIRE SECURITY IS 10 m AND IS TO BE CONFIRMED ACCORDING TO FIRE MANAGEMENT PLAN.
3. 5 m CLEARANCE HAS BEEN SET BETWEEN LEASE BOUNDARY AND PERIMETER FENCE FOR LANDSCAPING MITIGATION.
N
NEIGHBOURING PROPERTY
ESSENTIAL ENERGY 11,000 VOLT OVERHEAD LINE
MINIMUM 10m SETBACK TO CENTRE LINE OF PROPOSED TREES AS PER CODE
1.8m HIGH PRIVACY SCREENING ENCLOSURE - 20m x 20m
PROJECT LEASE BOUNDARY
PERIMETER FENCE
FUTURE DEVELOPMENT
TRAINING ZONE
LOT 211
DP 1069964
PROPOSED ACCESS ROAD
NEW ACCESS TO QUARRY CONNECTED TO EXISTING GRAVEL ROAD CONSTRUCTED TO RFS STANDARDS IN LOCATION DETERMINED BY T.R.C.
50m SETBACK
DETAIL B | PROPOSED ACCESS ROAD ROUTE WITH REGARDS TO FUTURE RURAL FIRE SERVICE
1:2000@A1
NOTES:
1. A NSW RURAL FIRE SERVICE (RFS) CONTROL CENTRE AND ACCESS WILL BE CONSTRUCTED TO THE WEST OF THE SITE. ACCESS TO THE PV ARRAY FROM THE EXISTING GRAVEL ROAD WILL BE DONE VIA A COMMON PRIVATE ROAD THAT WILL BE USE ALSO TO ACCESS TO THE NSW RFS CONTROL CENTRE.

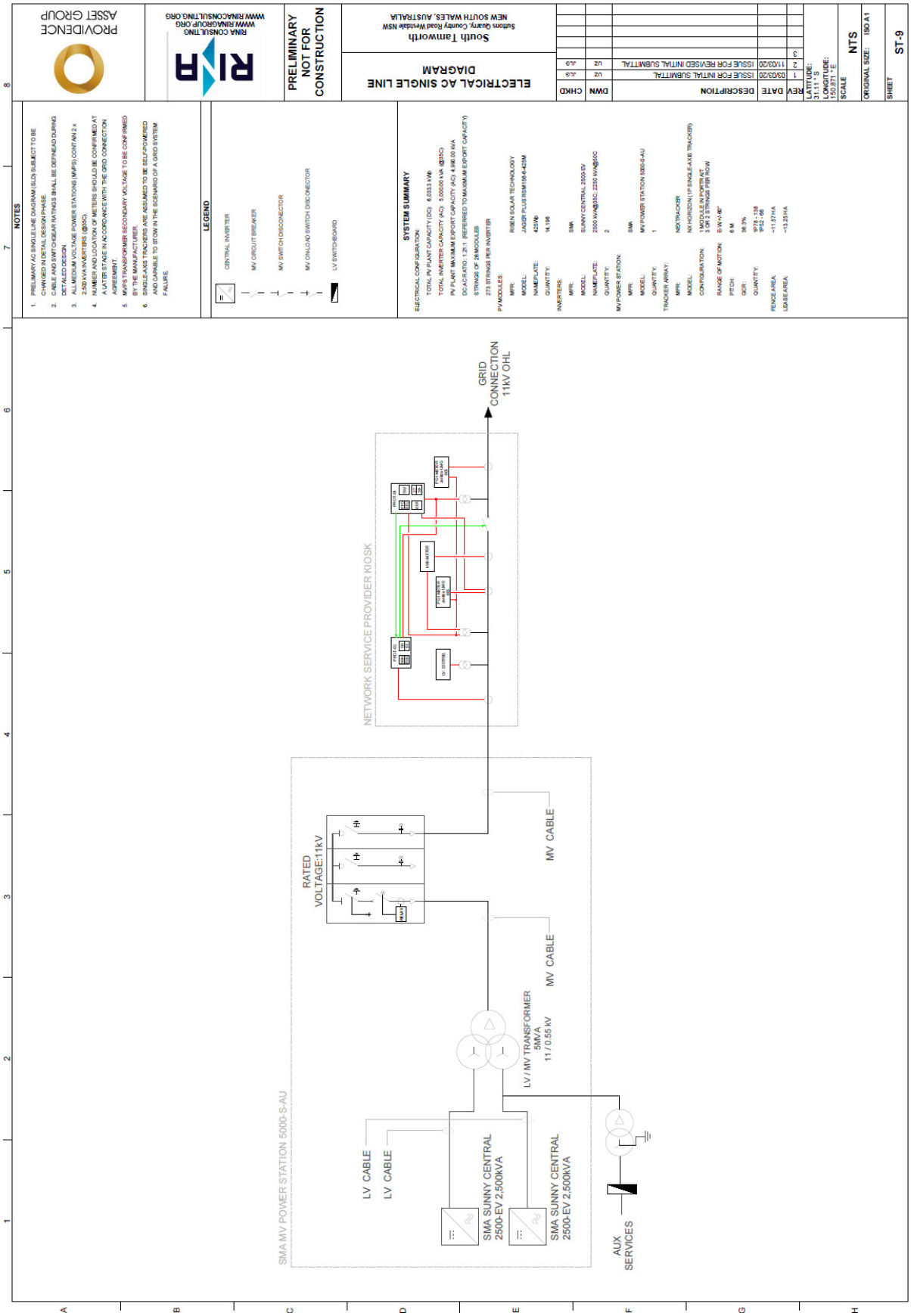

PROVIDENCE ASSET GROUP
RIVA CONSULTING
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PRELIMINARY NOT FOR CONSTRUCTION
CIVIL PLAN
South Tamworth
Suttons Quarry, Country Road Westdale NSW
NEW SOUTH WALES, AUSTRALIA
DESCRIPTION
ISSUE FOR INITIAL SUBMITTAL
ISSUE FOR REVISED INITIAL SUBMITTAL
LATITUDE: 31.11° S
LONGITUDE: 150.71° E
SCALE AS SHOWN
ORIGINAL SIZE: ISO A1
SHEET ST-4 [1/2]
LOCATION MAP - SCALE: 1:1,000,000
AUSTRALIA
PROJECT AREA
PoC
LEGEND
PROJECT LEASE BOUNDARY
EXISTING CONTOUR LINE
PERIMETER FENCE
EXISTING OVERHEAD LINE
PROPOSED ACCESS/MAINTENANCE ROAD
HARD STAND AND CONSTRUCTION LAYDOWN AREA
LOT BALANCE
PV ARRAY
APPROXIMATE EARTHWORKS LOCATION UNDERNEATH THE PV TRACKERS (GRADING)
POTENTIAL LANDSCAPE MITIGATION
PROPOSED GATE
EXISTING TREE
SYSTEM SUMMARY
ELECTRICAL CONFIGURATION:
TOTAL PV PLANT CAPACITY (DC): 6,033.3 kWp
TOTAL INVERTER CAPACITY (AC): 5,000.00 kVA (@35C)
PV PLANT MAXIMUM EXPORT CAPACITY (AC): 4,999.00 kVA
DC:AC RATIO: 1.21:1 (REFERRED TO MAXIMUM EXPORT CAPACITY)
STRINGS OF 26 MODULES
273 STRINGS PER INVERTER
PV MODULES:
MFR: RISEN SOLAR TECHNOLOGY
MODEL: JAGER PLUS RSM156-6-425M
NAMEPLATE: 425Wp
QUANTITY: 14,196
INVERTERS:
MFR: SMA
MODEL: SUNNY CENTRAL 2500-EV
NAMEPLATE: 2500 kVA@35C; 2250 kVA@50C
QUANTITY: 2
MV POWER STATION:
MFR: SMA
MODEL: MV POWER STATION 5000-SAU
QUANTITY: 1
TRACKER ARRAY:
MFR: NEXTRACKER
MODEL: NX HORIZON (IP SINGLE-AXIS TRACKER)
CONFIGURATION: 1 MODULE IN PORTRAIT 3 OR 2 STRINGS PER ROW
RANGE OF MOTION: E-W +/-60°
PITCH: 6 M
GCR: 36.3%
QUANTITY: 1979 - 138 1P52 - 66
FENCE AREA: ~11.57 HA
LEASE AREA: ~13.23 HA
N
DETAIL A | OVERVIEW OF CIVIL WORKS
1:1500@A1
LOT BALANCE
PV ARRAY
HARD STAND AND CONSTRUCTION LAYDOWN AREA
ACCESS ROAD
DETAIL B | EXISTING INFRASTRUCTURE AND EARTHWORKS
1:1500@A1
EPHIMERAL DRAINAGE LINE
EXISTING TREE LINE
EXISTING SINGLE TREE
PROJECT LEASE BOUNDARY
OVERHEAD LINE
PERIMETER FENCE
POTENTIAL LANDSCAPE MITIGATION
APPROXIMATE EARTHWORKS LOCATION UNDERNEATH THE PV TRACKERS (GRADING)
SITE ENTRANCE
ACCESS ROAD


PROVIDENCE ASSET GROUP
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PRELIMINARY NOT FOR CONSTRUCTION
TRACKER DETAILS
South Tamworth
Sutton Quarry, Country Road Westdale NSW
NEW SOUTH WALES, AUSTRALIA
REV DATE DESCRIPTION DWN CHKD
1 03/03/20 ISSUE FOR INITIAL SUBMITTAL UZ JLG
2 11/03/20 ISSUE FOR REVISED INITIAL SUBMITTAL UZ JLG
LATITUDE: 31.11° S
LONGITUDE: 150.871° E
SCALE AS SHOWN
ORIGINAL SIZE: ISO A1
SHEET ST-5
DETAIL A | TRACKER 1P78 (3 STRINGS) 1:120@A1
DETAIL B | TRACKER 1P52 (2 STRINGS) 1:120@A1
DETAIL C | SELF-POWERED MOTOR AND CONTROLLER NTS@A1
DETAIL D | DAMPER (TYPICALLY LOCATED AT EACH END OF THE ROW, TWO PER ROW) NTS@A1
DETAIL E | ARRAY SECTION 1:20@A1
INDICATIVE CLEARANCE TO GROUND RANGE SUPPORTED BY THE TRACKER
GENERAL NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS (UNLESS OTHERWISE SPECIFIED) AND ONLY INDICATIVE, TO BE CONFIRMED ON SITE PRIOR TO INSTALLATION.
2. A TYPICAL MODULES GROUND CLEARANCE OF 600 mm (WHERE LIVESTOCK GROUND CLEARANCE MAY NOT CASE BE LESS THAN 300 mm). GROUND CLEARANCE MAY VARY DEPENDING ON SITE TOPOGRAPHY AND REQUIRED EARTHWORKS FOR EACH CASE


PROVIDENCE ASSET GROUP
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PRELIMINARY NOT FOR CONSTRUCTION
POWER CONVERSION UNIT (PCU) DETAILS
South Tamworth
Sutton's Quarry, Country Road Westdale NSW
NEW SOUTH WALES, AUSTRALIA
DESCRIPTION
DATE
REV
DWN
CHKD
03/03/20 ISSUE FOR INITIAL SUBMITTAL 1 UZ JLG
11/03/20 ISSUE FOR REVISED INITIAL SUBMITTAL 2 UZ JLG
LATITUDE: 33.11° S
LONGITUDE: 150.871° E
SCALE AS SHOWN
ORIGINAL SIZE: ISO A1
SHEET ST-6
DETAIL A | EQUIPMENT ARRANGEMENT
NTS@A1
A - INVERTER SUNNY CENTRAL SC2500-EV
B - LV CABINET
C - MV SWITCHGEAR
D - CHANNEL FOR ARC PRESSURE RELEASE
E - MV TRANSFORMER
DETAIL B | END ELEVATION
1:30@A1
2438
DETAIL C | TOP VIEW
1:20@A1
2438
2260
89
89
INVERTER 2
MV TRANSFORMER
INVERTER 1
LV CABINET
MV SWITCHGEAR
4210
1416
6362
102
DETAIL D | SIDE ELEVATION
1:30@A1
3010
12192
GENERAL NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS (UNLESS OTHERWISE SPECIFIED) AND ONLY INDICATIVE, TO BE CONFIRMED ON SITE PRIOR TO INSTALLATION.
2. FENCING AROUND THE POWER CONVERSION UNIT SHOULD BE DEFINED DURING THE DETAILED DESIGN PHASE ACCORDING TO THE GEOTECHNICAL STUDIES AND FOOTING METHOD SUPPORTED BY THE PCU SUPPLIER (E.G. STRIP OR PILE FOUNDATION, PEA GRAVEL GROUND, SOLID COMPACTED GROUND AREAS, ETC.)


ACCESS ROADS AND DRIVEWAYS
South Tamworth
Subtons Quarry, Country Road Westdale NSW
NEW SOUTH WALES, AUSTRALIA
PRELIMINARY NOT FOR CONSTRUCTION
RINA CONSULTING
WWW.RINAGROUP.ORG
WWW.RINACONSULTING.ORG
PROVIDENCE ASSET GROUP
DESCRIPTION
DATE
REV
ISSUE FOR INITIAL SUBMITTAL
03/03/20
1
ISSUE FOR REVISED INITIAL SUBMITTAL
11/03/20
2
DWN
CHKD
UZ
JLG
LATITUDE:
31° 1' 15" S
LONGITUDE:
150.871° E
SCALE
AS SHOWN
ORIGINAL SIZE:
ISO A1
SHEET
ST-7
GENERAL NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS (UNLESS OTHERWISE SPECIFIED) AND ONLY INDICATIVE, TO BE CONFIRMED ON SITE PRIOR TO INSTALLATION.
2. THESE ARE ONLY INDICATIVE CROSS-SECTION OF THE ROAD TO BE REVIEWED DURING THE DETAILED DESIGN PHASE BASED ON GEOTECHNICAL AND DRAINAGE STUDIES
3. NUMBER OF FALLS FOR EACH ROAD TO BE CONFIRMED DURING THE DETAILED DESIGN PHASE BASED ON GEOTECHNICAL AND DRAINAGE STUDIES
4. FALL OF 2% IS TYPICAL BUT TO BE CONFIRMED IN DETAILED DESIGN PHASE
DETAIL A | INDICATIVE INTERNAL ROAD CROSS SECTION (TWO FALLS)
1:20@A1
MATCH EXISTING GRADE
3:1 MAX
4000
2% FALL
2% FALL
3:1 MAX
CLASS 6 AGGREGATE BASE COURSE
150
300
SUITABLE COMPACTED SUBGRADE MATERIAL
MATCH EXISTING GRADE
DETAIL B | INDICATIVE INTERNAL ROAD CROSS SECTION (ONE FALL)
1:20@A1
MATCH EXISTING GRADE
4:1 MAX
4000
2% FALL
CLASS 6 AGGREGATE BASE COURSE
150
4:1 MAX
300
SUITABLE COMPACTED SUBGRADE MATERIAL
MATCH EXISTING GRADE
DETAIL C | VEHICILE TURNING DETAIL PLAN
M 1:300@A1
R15000
4000

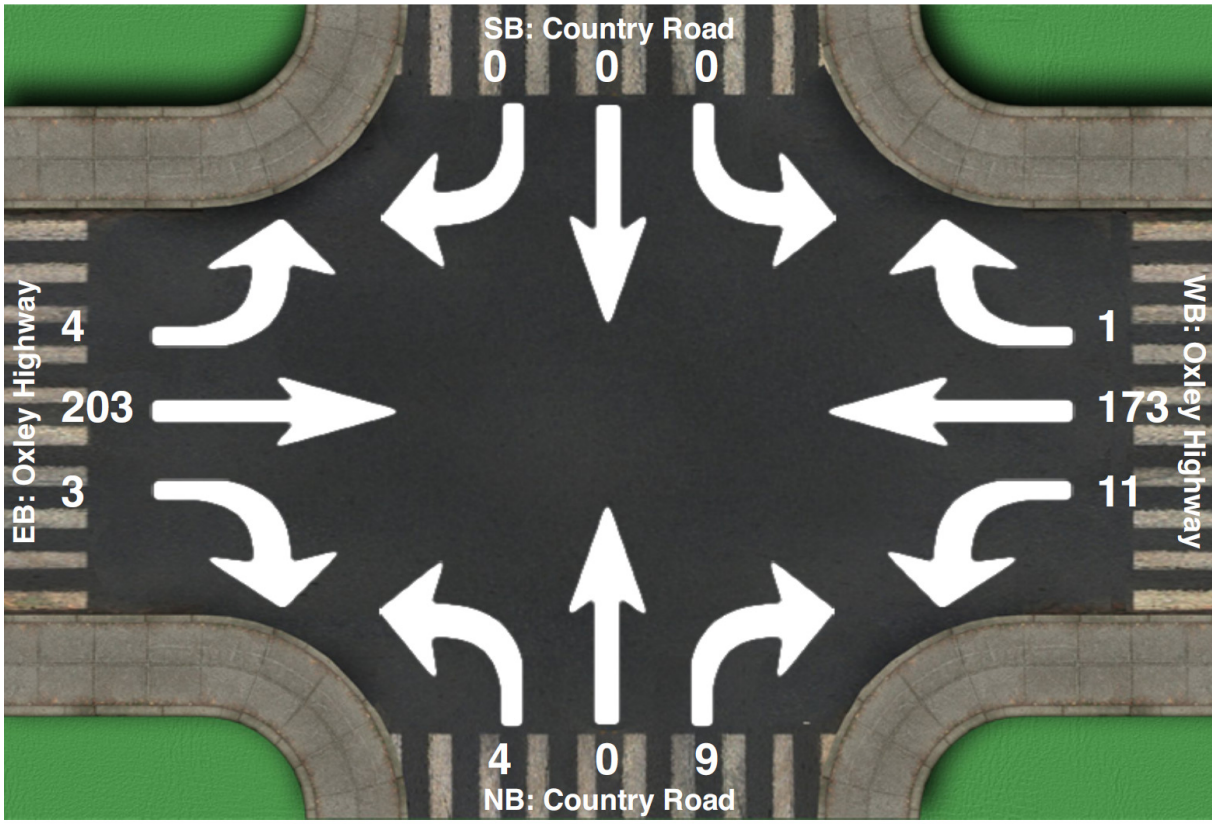

PROVIDENCE ASSET GROUP
RIVA CONSULTING
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WWW.RIVAGROUP.ORG
PRELIMINARY NOT FOR CONSTRUCTION
SECURITY FENCING DETAILS
South Tamworth
Sutton Quarry, Country Road Westdale NSW
NEW SOUTH WALES, AUSTRALIA
DESCRIPTION
DATE
REV
DWN
CHKD
ISSUE FOR INITIAL SUBMITTAL
03/03/20
1
ISSUE FOR REVISED INITIAL SUBMITTAL
11/03/20
2
LATITUDE: 31.11° S
LONGITUDE: 150.871 °E
SCALE AS SHOWN
ORIGINAL SIZE: ISO A1
SHEET ST-8
DETAIL A | INDICATIVE FRONT VIEW OF THE PERIMETER FENCE
1:20@A1
2000 mm LINE POST (ATTACH - LINE POST TIE)
BRACE RAIL (ATTACH - RAIL TIE)
7 GAUGE COIL WIRE (ATTACH - HOG RING)
45° B/W ARM
ADJUSTABLE TRUSS ROD
TURNBUCKLE
220 x 800 FOOTING
2500-3100
2500-3100
7 GAUGE COIL WIRE
60 mm DIAMOND MESH - 300 mm GAGE CHAIN LINK FABRIC, TOP SELVAGE TWISTED, BOTTOM SELVAGE KNUCKLED (TYP.)
TYPICALLY 2000 (TBD)
TYPICALLY 2200 (TBD)
DETAIL B | INDICATIVE FRONT VIEW OF THE VEHICLE ACCESS GATE
M 1:20@A1
60 mm DIAMOND MESH - 300 mm GAGE CHAIN LINK FABRIC
250 mm x 900 mm FOOTING (GATE AND CORNER POSTS ONLY)
GATE FRAME (TYP)
STRIKE STRAP
(3) STRANDS OF 12½ GAUGE BARBED WIRE FACE CONSISTING OF 2 STRAND LINE WIRE W/ 4PT BARBS
6000
2500 mm ROUND END & CORNER POST
TENSION ROD (TYP 4 SIDES)
10 mm ROUND ROD
GENERAL NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS (UNLESS OTHERWISE SPECIFIED) AND ONLY INDICATIVE, TO BE CONFIRMED ON SITE PRIOR TO INSTALLATION.
2. FENCE TYPE AND DIMENSIONS SHOULD BE DEFINED DURING THE DETAILED DESIGN PHASE BASED ON CLIENT REQUIREMENTS AND SITE CONSTRAINTS.
3. ACCESS GATE TYPE AND DIMENSIONS SHOULD BE DEFINED DURING THE DETAILED DESIGN PHASE BASED ON CLIENT REQUIREMENTS AND SITE CONSTRAINTS. PEDESTRIAN GATES MAY BE REQUIRED (TBD)


PROVIDENCE ASSET GROUP
RNA CONSULTING
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PRELIMINARY NOT FOR CONSTRUCTION
ELECTRICAL AC SINGLE LINE DIAGRAM
South Tamworth
Simms Quarry, Country Road Westdale NSW
NEW SOUTH WALES, AUSTRALIA
DESCRIPTION
DATE
REV
DWN
CHKD
ISSUE FOR INITIAL SUBMITTAL
ISSUE FOR REVISED INITIAL SUBMITTAL
LATITUDE: 31.11° S
LONGITUDE: 150.971 ° E
SCALE NTS
ORIGINAL SIZE: ISO A1
SHEET ST-9
NOTES
1. PRELIMINARY AC SINGLELINE DIAGRAM (SLD) SUBJECT TO BE CHANGED IN DETAIL DESIGN PHASE
2. CABLE AND SWITCHGEAR RATINGS SHALL BE DEFINED DURING DETAILED DESIGN
3. ALL MEDIUM VOLTAGE POWER STATIONS (MVPS) CONTAIN 2 x 2,500 KVA INVERTERS (@35C).
4. NUMBER AND LOCATION OF METERS SHOULD BE CONFIRMED AT A LATER STAGE IN ACCORDANCE WITH THE GRID CONNECTION AGREEMENT.
5. MVPS TRANSFORMER SECONDARY VOLTAGE TO BE CONFIRMED BY THE MANUFACTURER.
6. SINGLE-AXIS TRACKERS ARE ASSUMED TO BE SELF-POWERED AND CAPABLE TO STOW IN THE SCENARIO OF A GRID SYSTEM FAILURE.
LEGEND
CENTRAL INVERTER
MV CIRCUIT BREAKER
MV SWITCH DISCONNECTOR
MV ON-LOAD SWITCH DISCONNECTOR
LV SWITCHBOARD
SYSTEM SUMMARY
ELECTRICAL CONFIGURATION:
TOTAL PV PLANT CAPACITY (DC): 6.0333 kWp
TOTAL INVERTER CAPACITY (AC): 5.00000 kVA @35C)
PV PLANT MAXIMUM EXPORT CAPACITY (AC) 4,990.00 kVA
DC:AC RATIO: 1.21:1 (REFERRED TO MAXIMUM EXPORT CAPACITY)
8 STRINGS OF 26 MODULES
273 STRINGS PER INVERTER
PV MODULES:
MFR: RISEN SOLAR TECHNOLOGY
MODEL: JAGER PLUS RSM156-6-425M
NAMEPLATE: 425Wp
QUANTITY: 14,196
INVERTERS:
MFR: SMA
MODEL: SUNNY CENTRAL 2500-EV
NAMEPLATE: 2500 kVA@35C; 2250 kVA@50C
QUANTITY: 2
MV POWER STATION:
MFR: SMA
MODEL: MV POWER STATION 5000-S-AU
QUANTITY: 1
TRACKER ARRAY:
MFR: NEXTRACKER
MODEL: NX HORIZON (VP SINGLE-AXIS TRACKER)
CONFIGURATION: 1 MODULE IN PORTRAIT, 3 OR 2 STRINGS PER ROW
RANGE OF MOTION: E-W +/-60°
PITCH: 6 M
GCR: 36.3%
QUANTITY: 9°23 - 138
9°23 - 78
RENGE AREA: ~11.57 HA
LEASE AREA: ~12.29 HA
GRID CONNECTION 11kV OHL
NETWORK SERVICE PROVIDER KIOSK
SMA MV POWER STATION 5000-S-AU
RATED VOLTAGE:11kV
MV CABLE
MV CABLE
LV / MV TRANSFORMER 5MVA 11 / 0.55 kV
LV CABLE
LV CABLE
SMA SUNNY CENTRAL 2500-EV 2,500kVA
SMA SUNNY CENTRAL 2500-EV 2,500kVA
AUX SERVICES

ATTACHMENT B
TRAFFIC COUNT DATA

Intersection Peak Hour

Location: Country Road at Oxley Highway, Westdale
GPS Coordinates:
Date: 2020-03-18
Day of week: Wednesday
Weather:
Analyst: Jeff



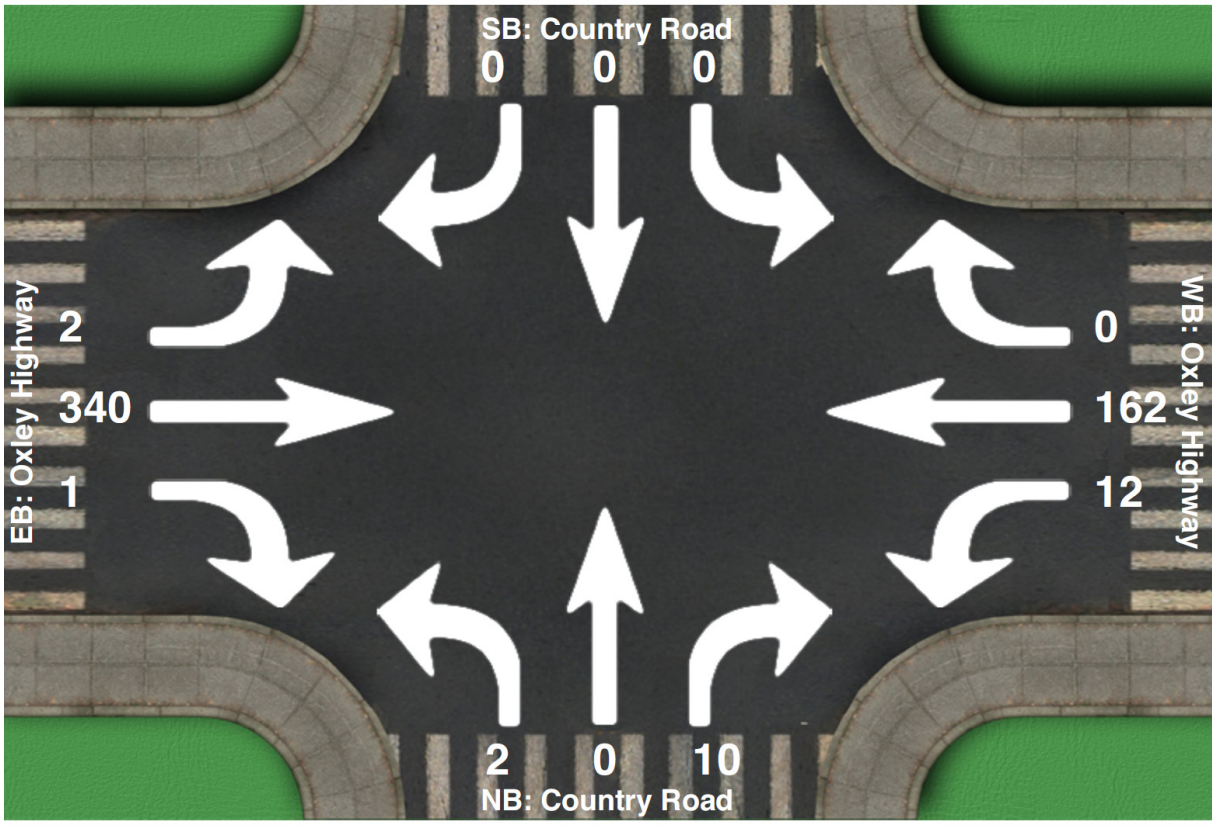
Intersection Peak Hour

08:00 - 09:00

	SouthBound			Westbound			Northbound			Eastbound			Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Vehicle Total	0	0	0	11	173	1	4	0	9	4	203	3	408
Factor	0.00	0.00	0.00	0.69	0.87	0.25	1.00	0.00	0.75	0.50	0.88	0.75	0.93
Approach Factor	0.00			0.86			0.81			0.88			

Intersection Peak Hour

Location: Country Road at Oxley Highway, Westdale
GPS Coordinates:
Date: 2020-03-17
Day of week: Tuesday
Weather:
Analyst: Jeff



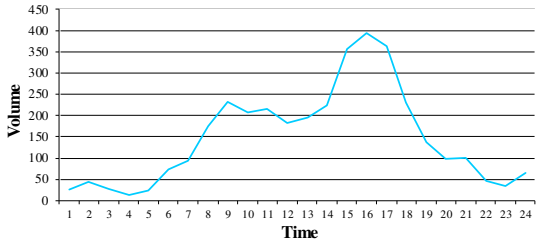
Intersection Peak Hour

15:00 - 16:00

	SouthBound			Westbound			Northbound			Eastbound			Total
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Vehicle Total	0	0	0	12	162	0	2	0	10	2	340	1	529
Factor	0.00	0.00	0.00	0.75	0.90	0.00	0.50	0.00	0.36	0.50	0.67	0.25	0.76
Approach Factor	0.00			0.93			0.43			0.68			

Site 2 Oxley Hwy E of Country Rd [60] **Eastbound**

Day	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*	*Sun*	*Mon*	*W/Day*	*W/End*	*7 Day*
Time	10/03/20	11/03/2020	12/03/2020	13/03/2020	14/03/2020	15/03/2020	16/03/2020	*Ave.*	*Ave.*	*Ave*
0:00	20	54	25	24	31	4	10	27	18	24
1:00	72	44	61	44	54	3	3	45	29	40
2:00	24	15	41	51	20	9	10	28	15	24
3:00	10	13	13	20	13	6	12	14	10	12
4:00	30	22	25	26	14	4	13	23	9	19
5:00	72	66	79	81	50	9	65	73	30	60
6:00	95	105	100	87	45	10	81	94	28	75
7:00	181	180	163	170	79	39	175	174	59	141
8:00	214	235	231	249	130	85	234	233	108	197
9:00	195	203	223	214	203	122	203	208	163	195
10:00	246	212	198	234	219	116	195	217	168	203
11:00	192	178	185	182	170	140	173	182	155	174
12:00	196	180	190	218	176	151	198	196	164	187
13:00	208	267	212	221	117	171	218	225	144	202
14:00	306	320	313	426	136	147	420	357	142	295
15:00	440	413	378	368	134	197	369	394	166	328
16:00	349	365	400	406	145	169	296	363	157	304
17:00	246	216	251	236	114	160	208	231	137	204
18:00	125	153	141	162	85	116	105	137	101	127
19:00	74	97	106	158	56	83	59	99	70	90
20:00	122	68	113	98	46	44	100	100	45	84
21:00	55	52	39	52	26	75	39	47	51	48
22:00	20	26	31	53	26	20	43	35	23	31
23:00	58	53	52	58	15	15	109	66	15	51
Total	**3550**	**3537**	**3570**	**3838**	**2104**	**1895**	**3338**	**3567**	**2000**	**3119**

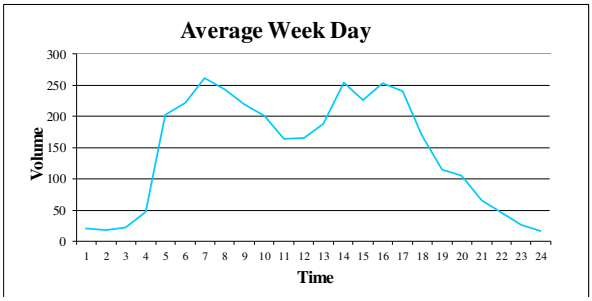


Summary

	from	to	
AM Peak	8:00 AM	9:00 AM	**249**
PM Peak	3:00 PM	4:00 PM	**440**
		Week Day Average	**3567**
		Weekend Day Average	**2000**
		7 Day Average	**3119**

Site 2 Oxley Hwy E of Country Rd [60] **Westbound**

Day	*Tue*	*Wed*	*Thu*	*Fri*	*Sat*	*Sun*	*Mon*	*W/Day*	*W/End*	*7 Day*
Time	10/03/20	11/03/2020	12/03/2020	13/03/2020	14/03/2020	15/03/2020	16/03/2020	*Ave.*	*Ave.*	*Ave*
0:00	19	22	27	21	17	6	13	20	12	18
1:00	21	12	22	17	13	6	19	18	10	16
2:00	27	8	29	25	4	6	20	22	5	17
3:00	46	46	50	59	12	10	36	47	11	37
4:00	190	184	194	206	38	17	240	203	28	153
5:00	243	232	225	203	72	19	210	223	46	172
6:00	276	264	291	249	62	36	231	262	49	201
7:00	263	212	237	237	99	62	270	244	81	197
8:00	208	268	186	224	130	76	210	219	103	186
9:00	207	186	227	196	162	109	193	202	136	183
10:00	145	192	145	186	149	107	155	165	128	154
11:00	165	166	158	183	141	124	161	167	133	157
12:00	199	198	195	178	186	149	170	188	168	182
13:00	209	250	240	289	168	169	287	255	169	230
14:00	227	228	215	254	164	193	212	227	179	213
15:00	280	228	252	286	169	137	221	253	153	225
16:00	258	243	248	249	123	139	205	241	131	209
17:00	184	165	166	173	98	121	164	170	110	153
18:00	94	111	121	152	86	103	96	115	95	109
19:00	102	95	117	127	51	74	87	106	63	93
20:00	55	65	77	84	24	55	48	66	40	58
21:00	65	34	41	54	34	33	34	46	34	42
22:00	14	20	28	41	22	20	28	26	21	25
23:00	18	14	15	19	13	17	19	17	15	16
Total	**3515**	**3443**	**3506**	**3712**	**2037**	**1788**	**3329**	**3501**	**1913**	**3047**



Summary

	from	to	
AM Peak	6:00 AM	7:00 AM	**291**
PM Peak	1:00 PM	2:00 PM	**289**
		Week Day Average	**3501**
		Weekend Day Average	**1913**
		7 Day Average	**3047**

ATTACHMENT C
TRAFFIC GENERATION INFORMATION

Preliminary Manilla SF Vehicle Movement Guidance

Jake May, 05/02/2020

1 Traffic Generated by Construction Works

During the construction of the solar farm, it is estimated that approximately 50 x 40 ft containers will be transported to site. Added to these containers are waste traffic, equipment, temporary installations and workforce transport to and from site. A logistics agent will be engaged to manage the freight from the delivery port [TBC] to the solar farm site.

An estimation of the traffic created by the worksite is provided in Figure 1, below.

The vehicular traffic for the transport vehicles is based on a 3-axle rigid truck. The General Mass Limit (GML) for a 3-axle load is assumed to be 20 tonnes based on The Australian Trucking Association's 'Technical Advisory Procedure for Truck Configurations' [24]. Depending on the availability of vehicles it may be possible that a conventional B-doubles will transport equipment to site. The GML for this vehicle is 40 tonnes. In this case the vehicular traffic for the container loads will reduce by a factor of 2 for each B-double transporting equipment to site.

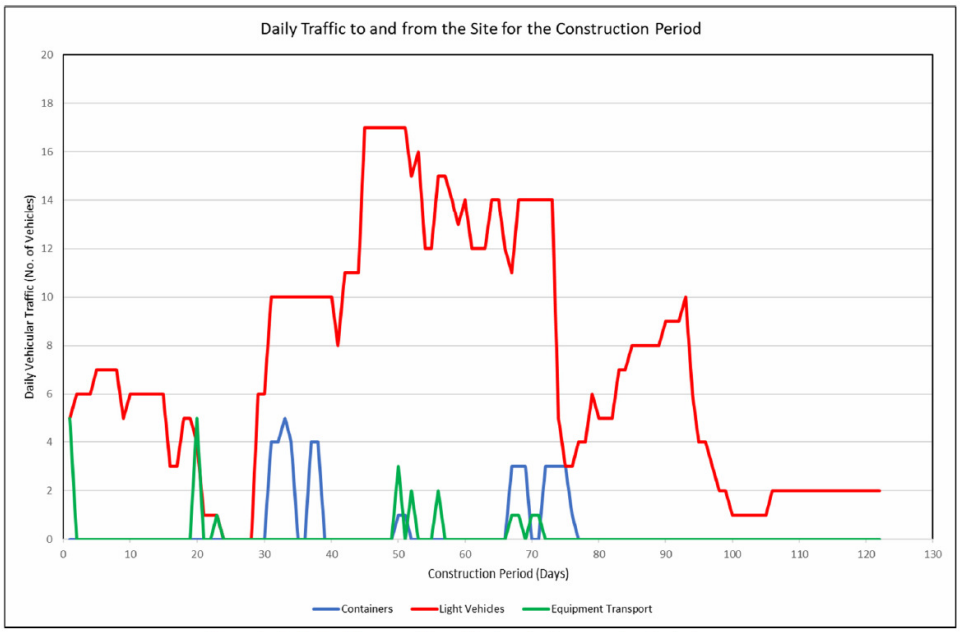


Figure 1 - Daily Traffic to and from Site for the Construction Period

At the peak of the equipment supply, the number of transport vehicles entering and leaving the solar farm site will be 4 to 5 daily for a period of just over a month into the construction period. There will be another busy week midway through the construction period where there will be approximately 3 transport vehicles entering and leaving the site daily.

All heavy transport to and from the site will predominantly be on standard working days between 8am and 4pm.

It is anticipated that there will be up to 30 personnel working on the site during the construction period that will generate the anticipated light vehicle traffic.

The light traffic will be concentrated at the beginning and the end of the day around 6-7am and 4-5pm. The container transport will be concentrated between 10am and 3pm.

2 Impact on Existing Traffic

With a maximum of eight to ten light vehicles and six to eight heavy vehicles travelling to and from the site daily, it is not anticipated that the increased traffic due to construction works will have any significant impact on the existing traffic.

3 Additional Road Signage of Existing Road

It is suggested that road signage is provided for the proposed site entrance on Manilla Road. The recommended locations of the warning signs be placed at distances of 200 metres approaching the intersection to the north and south. The warning signs will indicate that it is a construction site entrance. The entrance to the site on Mannum Road will be designed for the anticipated heavy transport loads volumes during the construction period that are detailed in Section 1. A Traffic Control Plan will be submitted to the DPTI Traffic Management Centre for approval, with all signage to be placed and maintained to the satisfaction of the Commissioner of Highways.

4 Parking

All parking for site personnel will be on site. This will be sign posted at the site entrance. Balance will not permit parking on Mannum Road and will incorporate this in the site induction.

5 O&M Traffic

Once the solar farm has been constructed and has entered the “operations and maintenance” stage the traffic onto site will consist of light vehicles, with few exceptions, at a frequency of 1 to 5 visits per fortnight.

5MW Solar Farm - Typical Vehicle Movements			
Construction - Major Equipment	Load	Quantity	Comments
Piling & Tracker Components	40' Container / Trailer	24	Doubles if permitted / practical
PV Modules	40' Container / Trailer	26	Doubles if permitted / practical
Switchgear	20' Container / Trailer	1	
Inverters	20' Container / Trailer	2	
Cranes	~50T	3	
Cables	40' Container / Trailer	2	Doubles if permitted / practical
Balance of Plant (BOP)	40' Container / Trailer	3	
Civil Plant	Float or Drop Deck	8	4ea at mob / demob
Piling Plant	Float or Drop Deck	4	2ea at mob / demob
Site Facilities	Float/Drop Deck/40' Trailer	8	4ea at mob / demob
Light trucks - 6 wheelers	local deliveries - sand, gen fteight etc	10	
Light trucks - 4 wheelers	local deliveries - sand, gen fteight etc	10	
		101	
Construction - Light Vehicles / Other	Load	Quantity	Comments
Light Vehicle - 4WD ute or similar	Personell / tools	384	Average 4 per day
Light Vehicle - ?	Workforce private vehicles	576	Average 6 per day - depends on engagement of workforce
		960	
O&M	Load	Quantity	Comments
Light Vehicle - 4WD ute or similar	fortnightly inspection	30	1 per fortnight, plus additional
Light Vehicle - 4WD ute or similar	3 monthly Inspections	8	2 visits, 4 times per year
Light Vehicle - 4WD ute or similar	Faults	4	
Light trucks - 4 wheelers	PV Module cleaning	2	Once per Year
		44	

ATTACHMENT D
SIDRA SUMMARY TABLES

MOVEMENT SUMMARY

▽ Site: 101 [2020AM]

Oxley Highway / Country Road T-intersection Westdale
March 2020 counts
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Country Road												
1	L2	4	10.0	0.004	6.4	LOS A	0.0	0.1	0.28	0.54	0.28	52.3
3	R2	9	10.0	0.016	9.1	LOS A	0.1	0.4	0.50	0.66	0.50	50.4
Approach		14	10.0	0.016	8.3	LOS A	0.1	0.4	0.43	0.62	0.43	51.0
East: Oxley Highway												
4	L2	12	10.0	0.007	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
5	T1	183	10.0	0.100	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		195	10.0	0.100	0.3	NA	0.0	0.0	0.00	0.03	0.00	59.5
West: Oxley Highway												
11	T1	218	10.0	0.099	0.0	LOS A	0.0	0.2	0.01	0.01	0.01	59.9
12	R2	3	10.0	0.099	6.6	LOS A	0.0	0.2	0.01	0.01	0.01	57.7
Approach		221	10.0	0.099	0.1	NA	0.0	0.2	0.01	0.01	0.01	59.8
All Vehicles		429	10.0	0.100	0.5	NA	0.1	0.4	0.02	0.04	0.02	59.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

▽ Site: 101 [2020PM]

Oxley Highway / Country Road T-intersection Westdale
March 2020 counts
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Country Road												
1	L2	2	10.0	0.002	6.3	LOS A	0.0	0.1	0.27	0.53	0.27	52.4
3	R2	11	10.0	0.022	10.9	LOS A	0.1	0.6	0.56	0.72	0.56	49.2
Approach		13	10.0	0.022	10.2	LOS A	0.1	0.6	0.51	0.69	0.51	49.7
East: Oxley Highway												
4	L2	13	10.0	0.007	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
5	T1	171	10.0	0.093	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		183	10.0	0.093	0.4	NA	0.0	0.0	0.00	0.04	0.00	59.5
West: Oxley Highway												
11	T1	360	10.0	0.160	0.0	LOS A	0.0	0.1	0.00	0.00	0.00	60.0
12	R2	1	10.0	0.160	6.6	LOS A	0.0	0.1	0.00	0.00	0.00	57.8
Approach		361	10.0	0.160	0.0	NA	0.0	0.1	0.00	0.00	0.00	60.0
All Vehicles		557	10.0	0.160	0.4	NA	0.1	0.6	0.01	0.03	0.01	59.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

▽ Site: 101 [2020AM + construction traffic]

Oxley Highway / Country Road T-intersection Westdale
March 2020 counts
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Country Road												
1	L2	4	10.0	0.004	6.4	LOS A	0.0	0.1	0.28	0.54	0.28	52.3
3	R2	14	10.0	0.024	9.3	LOS A	0.1	0.7	0.50	0.67	0.50	50.3
Approach		18	10.0	0.024	8.6	LOS A	0.1	0.7	0.45	0.64	0.45	50.8
East: Oxley Highway												
4	L2	26	10.0	0.015	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
5	T1	183	10.0	0.100	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		209	10.0	0.100	0.7	NA	0.0	0.0	0.00	0.07	0.00	59.0
West: Oxley Highway												
11	T1	218	10.0	0.099	0.0	LOS A	0.0	0.2	0.01	0.01	0.01	59.9
12	R2	3	10.0	0.099	6.7	LOS A	0.0	0.2	0.02	0.01	0.02	57.7
Approach		221	10.0	0.099	0.1	NA	0.0	0.2	0.01	0.01	0.01	59.8
All Vehicles		448	10.0	0.100	0.7	NA	0.1	0.7	0.02	0.06	0.02	59.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

▽ Site: 101 [2020PM + construction traffic]

Oxley Highway / Country Road T-intersection Westdale
March 2020 counts
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Country Road												
1	L2	2	10.0	0.002	6.3	LOS A	0.0	0.1	0.27	0.53	0.27	52.4
3	R2	25	10.0	0.054	11.2	LOS A	0.2	1.5	0.57	0.77	0.57	49.0
Approach		27	10.0	0.054	10.8	LOS A	0.2	1.5	0.55	0.75	0.55	49.3
East: Oxley Highway												
4	L2	17	10.0	0.010	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
5	T1	171	10.0	0.093	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		187	10.0	0.093	0.5	NA	0.0	0.0	0.00	0.05	0.00	59.3
West: Oxley Highway												
11	T1	360	10.0	0.160	0.0	LOS A	0.0	0.1	0.00	0.00	0.00	60.0
12	R2	1	10.0	0.160	6.7	LOS A	0.0	0.1	0.00	0.00	0.00	57.8
Approach		361	10.0	0.160	0.0	NA	0.0	0.1	0.00	0.00	0.00	60.0
All Vehicles		576	10.0	0.160	0.7	NA	0.2	1.5	0.03	0.05	0.03	59.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
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Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

▽ Site: 101 [2020AM + construction traffic sensitivity]

Oxley Highway / Country Road T-intersection Westdale
March 2020 counts
Site Category: (None)
Giveway / Yield (Two-Way)
Flow Scale Analysis (Upper Limit): Results for Flow Scale (chosen as largest for any movement) = 124.0 %

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Country Road												
1	L2	5	10.0	0.005	6.6	LOS A	0.0	0.1	0.32	0.55	0.32	52.2
3	R2	17	10.0	0.035	10.6	LOS A	0.1	0.9	0.56	0.73	0.56	49.4
Approach		22	10.0	0.035	9.7	LOS A	0.1	0.9	0.50	0.69	0.50	50.0
East: Oxley Highway												
4	L2	33	10.0	0.019	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
5	T1	227	10.0	0.124	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		260	10.0	0.124	0.7	NA	0.0	0.0	0.00	0.07	0.00	59.0
West: Oxley Highway												
11	T1	270	10.0	0.122	0.0	LOS A	0.0	0.3	0.01	0.01	0.01	59.9
12	R2	4	10.0	0.122	7.1	LOS A	0.0	0.3	0.02	0.01	0.02	57.7
Approach		274	10.0	0.122	0.1	NA	0.0	0.3	0.01	0.01	0.01	59.8
All Vehicles		556	10.0	0.124	0.8	NA	0.1	0.9	0.03	0.07	0.03	59.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MOVEMENT SUMMARY

▽ Site: 101 [2020PM + construction traffic - sensitivity]

Oxley Highway / Country Road T-intersection Westdale
March 2020 counts
Site Category: (None)
Giveway / Yield (Two-Way)
Flow Scale Analysis (Upper Limit): Results for Flow Scale (chosen as largest for any movement) = 124.0 %

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Country Road												
1	L2	3	10.0	0.003	6.5	LOS A	0.0	0.1	0.30	0.54	0.30	52.3
3	R2	31	10.0	0.084	13.6	LOS A	0.3	2.2	0.66	0.86	0.66	47.4
Approach		34	10.0	0.084	13.1	LOS A	0.3	2.2	0.63	0.83	0.63	47.8
East: Oxley Highway												
4	L2	21	10.0	0.012	5.7	LOS A	0.0	0.0	0.00	0.57	0.00	53.2
5	T1	211	10.0	0.115	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	60.0
Approach		232	10.0	0.115	0.5	NA	0.0	0.0	0.00	0.05	0.00	59.3
West: Oxley Highway												
11	T1	446	10.0	0.198	0.0	LOS A	0.0	0.1	0.00	0.00	0.00	60.0
12	R2	1	10.0	0.198	7.0	LOS A	0.0	0.1	0.00	0.00	0.00	57.8
Approach		448	10.0	0.198	0.0	NA	0.0	0.1	0.00	0.00	0.00	60.0
All Vehicles		714	10.0	0.198	0.8	NA	0.3	2.2	0.03	0.06	0.03	59.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
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HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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MARA CONSULTING



Visual Impact Assessment

South Tamworth Solar Farm

Providence Asset Group

03 April 2020

PROVIDENCE ASSET GROUP

Mara Consulting

Consultation + Urban Design

Creating vibrant communities through powerful conversations

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Project Name	
Location	Country Road, Westdale NSW
Project Number	2016
Client	Providence Asset Group
Mara Consulting Document	20200403_2016_Mara_Providence-South Tamworth VIA-RevB

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Revision	Date of issue	Details	Author	Approved
A	30/03/2020	Draft	TA	KL
B	03/04/2020	For submittal	TA	KL

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1. Introduction

1.1. Background

This report is meant to aid in the approval process for the proposed solar farm near Tamworth, NSW. The site is Suttons Quarry, located at Country Road, Westdale NSW. The proposed development will consist of solar panels with supporting inverters and switchboards with an access road from Country Road. The development will be fully contained within Lot 211 DP1069964.

This visual impact assessment has been prepared to identify and evaluate the visual impacts on the landscape and to recommend measures to minimise the visual impact of the proposed development.

This report describes the existing visual environment and provides a methodology to assess the visual sensitivity of the site and to assess the visual impact of the planned development. Viewing zones and significant viewing locations within each zone are identified and assessed.

1.2. The site and context

The site is situated approximately 1.6km south of Gunnedah Road, along the eastern side of Country Road. The Tamworth airport is located 3.5km northwest of the site.

The site sits on a rise with the ridgeline running north-south within the property boundaries. The proposed solar farm will be situated east of the ridgeline, on the east facing slope. Immediately south of the solar farm site is a quarry made up of two large pits.

The landscape surrounding the site is predominantly agricultural land, dominated by grazing paddocks. There are occasional residential/farm house structures with associated structures.

The closest residential communities are approximately 1.8km to the east and north, with Tamworth beyond.



Image: View of the solar farm site from the east.



Figure 1.1. Site location (shown in red)
Aerial from SIXmaps (2020).

2. Methodology

2.1. Background

This section provides a methodology for the visual impact assessment. The methodology used in this assessment has been adapted from the Roads and Maritime Services *Environmental Impact Assessment Guidance Note (2013): Guidelines for landscape character and visual impact assessment.* This methodology has been used as a guide to align with the features and requirements of this Proposal.

The methodology for assessing the visual impact includes the following key processes:

- Section 2.2 identifies the existing visual environment, the significant landscape features of the site and the visibility of the site from the significant vantage points
- Section 2.3 provides an assessment criteria that describes site visibility and visual absorption capacity
- Section 2.4 identifies viewing zones from which the site could be visible from various distances within the immediate vicinity, local area and regional context
- Section 3 provides an overview of the proposed development
- Section 4 assesses the potential visual impact from a variety of viewing locations
- Section 5 provides photomontages
- Section 6 provides a reflection and glare analysis
- Section 7 recommended mitigation measures.

2.2. Existing visual environment

This section describes the character and visibility of the site from the surrounding area.

2.2.1. Landscape character

Tamworth and the surrounding suburbs are located along the Peel River, which runs in a north westerly direction. The rivercourse marks the lowest areas along the floor of a wide valley or plain. To the east of the river, the land rises to meet the base of Flagstaff Mountain. To the west, the land is undulating with low hills that form the plain.

The solar farm site sits near the top of a low hill west of the outlying residential communities. The surrounding area is characterised by open agricultural land that is fenced into paddocks. The vegetation in the surrounding area is mainly grassy paddocks used for grazing purposes. Rows of trees exist along the north and eastern boundaries of the development site.

Clumps of mature trees occur throughout the landscape, marking residential buildings, drives and boundaries.

2.2.2. Site visibility

The procedure for assessing site visibility involved:

- Determination of various viewing zones (regional, local and immediate vicinity)
- Detailed field investigations to plot those portions of the site that are visible from the various viewing zones.

2.3. Assessment criteria

The potential visual impact of planned development would result from the combination of two factors:

- Visibility of development
- Visual absorption capacity of the landscape in which the development occurs.

The visibility and the visual absorption capacity of the site for each representative view location have been assessed to determine the overall visual impact. Visibility and visual absorption capacity are defined below.

2.3.1. Visibility

"Visibility" is a measure of the extent to which particular activities/ components of a proposal may be visible from surrounding areas, the relative number of viewers, the period of view, viewing distance and context of view. The rationale for the assessment is that if a proposal is not visible the impact is nil and if the number of people who would potentially see the proposal is low, then the visual impact would be lower than if a potential large number of people had the same view.

For the purpose of this study, the general categories of visibility have been defined broadly as:

- **High (H)** – where a large number of people would see new development at short distance over a short, moderate or long period of time
- **Moderate (M)** – where a small number of people would see new development at a short or medium distance over a moderate or long period of time, or a moderate number of people would see the new development at a medium distance over a short, moderate or long period of time, or a large number of people would see it at a medium or long distance over a short period of time
- **Low (L)** – where a small number of people would see new development at long distance over a short (< 1 minute), moderate (< 1-10 minutes) or long (> 10 minutes) period of time.

The procedure for assessing site visibility involved:

- Determination of viewing locations from which parts of the planned development could potentially be visible (eg. by a motorist, visitor, resident)
- A field inspection to determine the extent of site visibility from the various viewing locations.

2.3.2. Visual absorption criteria

"Visual Absorption Capacity" is an estimation of the capacity of the landscape to absorb development without creating significant visual change. The capacity to absorb development is primarily dependent on land form, vegetation cover and the presence of other development.

The extent to which portions of the site can potentially absorb development without reducing the scenic quality of the area has been assessed under this criteria. Given the visual landscape character of the site this capacity is primarily dependent on repetition of built form and vegetation cover. The surrounding building and tree canopies provide capacity to visually absorb development without significantly changing its scenic quality provided vegetation is retained in public and private land.

The potential for development to significantly change the visual character or to reduce the scenic quality of the area will result from removal of portions of the tree cover and creation of visual contrast between development (buildings, roads and new landscape) and the existing landscape of surrounding areas.

The level of contrast is also strongly influenced by the nature of the backdrop against which development is viewed. In particular, structures that are viewed above the skyline will potentially create a higher degree of contrast that the same elements viewed against a backdrop of similar structures or a landscape of similar colour/textures as the building or structure.

The degree of contrast between proposed development and the existing landscape (buildings and vegetation) can be reduced by careful attention to the colour, scale, texture, and reflectivity of building materials and by avoiding development that breaks the height of the existing tree canopy. Where possible these considerations are to be incorporated into the design and siting of buildings, roads and other structures.

Table 2.1: Visual absorption criteria.

Criteria	Definition
High	Existing landscape and built environment able to absorb development. Low degree of visual contrast
Medium	Existing landscape able to absorb some development. Some visual contrast will result.
Low	Existing landscape unable to absorb development (unless the denser future character of an area is to deliberately make a development prominent such as a public building or special focus). High degree of visual contrast will result.

2.3.3. Visual Impact Rating

Table 2.2 provides a matrix that compares the visibility rating with the visual absorption capacity rating to determine the visual impact rating.

Table 2.2: Visual impact rating matrix

		Visibility		
		Low	Moderate	High
Visual Absorption Capacity	High	Low	Low	Moderate
	Medium	Low	Moderate	High
	Low	Moderate	High	High

2.4. Viewing zones

Viewing zones are areas outside the site that have potential views into the site. These are categorised by distance since visibility diminishes with distance. The categories are the immediate vicinity, local area and regional context.

The site of the proposed solar farm is located along Country Road with a ridge bisecting the site. The solar arrays will be located east of the ridgeline. The ridge will eliminate any views from the west beyond the immediate vicinity of the site.

The slope that will contain the solar arrays faces east, toward Tamworth and its suburbs. Because of the slope and the open paddocks, views of the solar arrays can potentially occur from any vantage point east of the site.

The viewing zones and viewshed is illustrated in Figures 2.2 and 2.3.

In order to assess the potential visual impacts of the proposed building, viewing zones based on the distance from the proposed development were defined as follows:

- Immediate vicinity (< 1.5km)
- Local area (1.5km – 3km)
- Regional area (3km – 6km).

Representative view locations were selected from each zone and the visual impact of the planned development has been assessed from each location.

Immediate vicinity (< 1.5km).

- View 1: Country Road, Westdale

Local area (1.5km – 3km).

- View 2: 32 New Winton Road, Westdale
- View 3: 29 Flemming Crescent, West Tamworth
- View 4: Cnr Gunnedah Road and Cole Road, Taminda
- View 5: 300 Warral Road, Warral.

Regional area (3km – 6km).

- View 6: 3 Barreng Street, Hillvue
- View 7: 21 Ventnor Drive, North Tamworth.

Each view is addressed separately in Section 4 of this report.

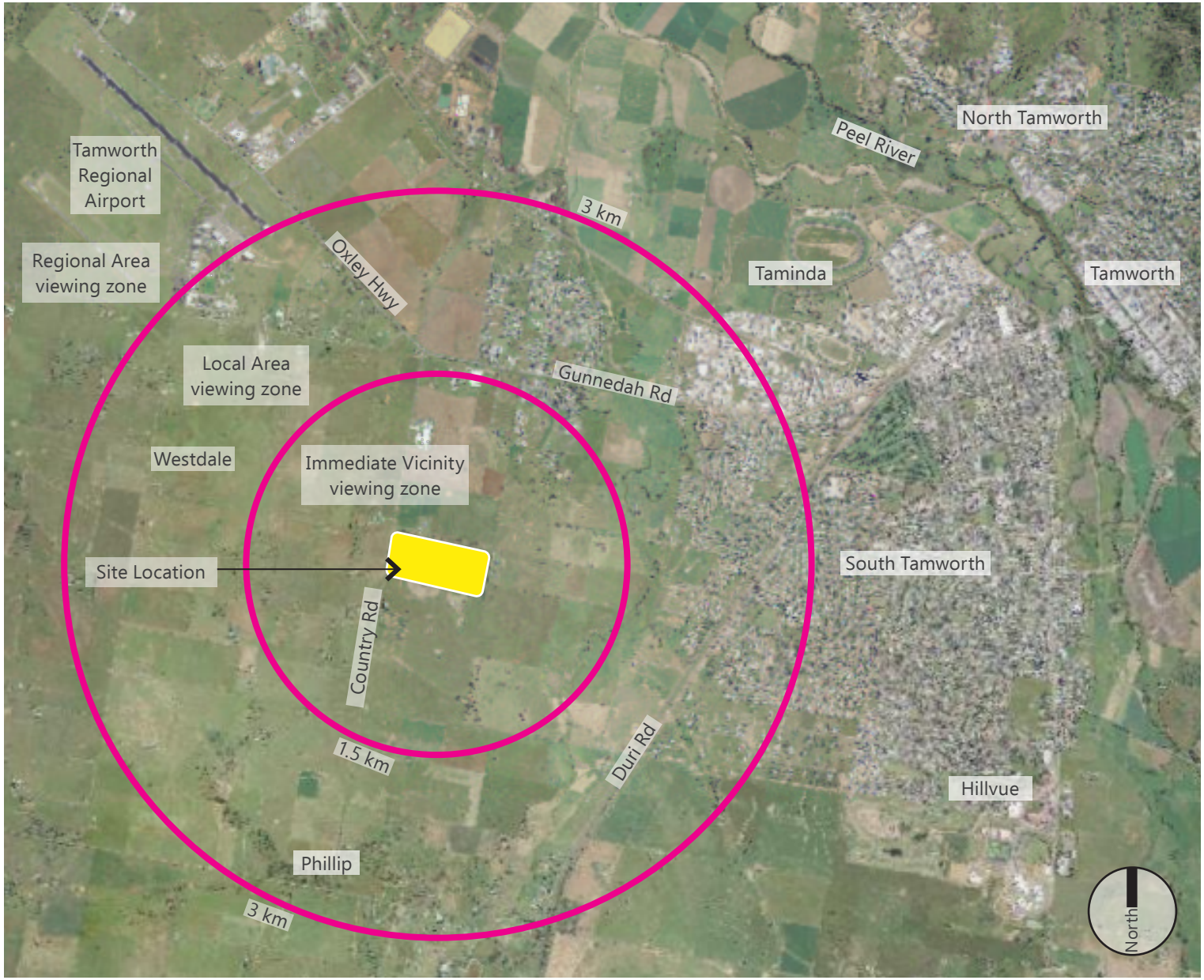


Figure 2.2: Viewing Zones
The viewing zones indicated as distance from the subject site. Figure 2.3 shows specific locations of each viewpoint that will be discussed in Section 4.



Figure 2.3: Viewing Locations
The view locations are shown with arrows. The number on the arrows are associated with the visual assessment in Section 4 of this report

3. Proposal

3.1. Project Description

The proposed Solar Farm is located approximately 1.5km south of Gunnedah Road, within the Tamworth Regional Council local government area.

The site is located approximately 3.5km from Tamworth Regional Airport and covers an area of approximately 11.6 hectares. An indicative layout for the proposal has been provided (refer to Figure 3.1). This layout may be refined following the findings of various studies, of which this VIA is one.

3.1.1. Indicative project layout

The solar electricity generating facility will consist of the following elements:

- Solar array area up to 11.6Ha
- Solar array mounted on trackers (204 sets)
  - Rectangular photovoltaic module
  - Trackers area horizontal single-axis type, 1.5m high with +/-60° rotation angle
  - Trackers oriented north-south
- Associated infrastructure
  - Power Conversion Unit (PCU)
  - Site access from Country Road via a 4m wide road
  - Security fencing
  - Car park area
  - Off-load area

During construction, temporary facilities located within the site may include:

- Construction office

3.1.2. Solar panel dimensions and arrangement

The proposed solar array module dimensions are approximately 1m wide x 2m high. They are mounted on a tracking system that will maximise the electricity production. The tracking system rotates about a north-south axis to follow the sun with the aim of orienting each panel perpendicular to the incoming sun.

The tracking systems will be arranged in rows running in a north-south direction as indicated in Figure 3.1. The enclosure for the solar panel arrays and other equipment will cover about 11.6Ha.

The diagram in Figure 3.2 illustrates the dimensions and rotation of the panels. The panels only rotate from east to west and are not tilted toward the north.



Image: Solar panels similar to the proposed development.

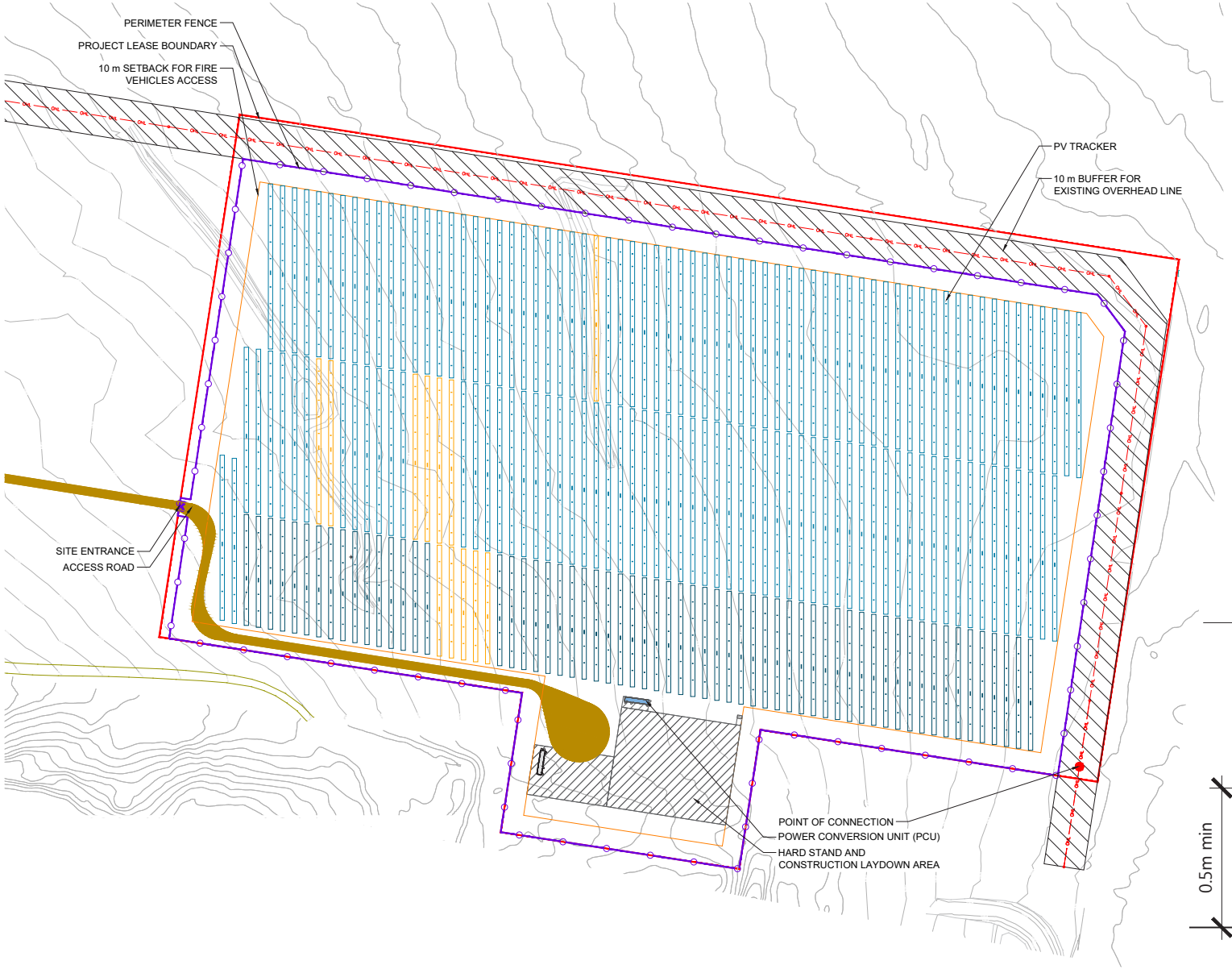


Figure 3.1: Concept layout of the project

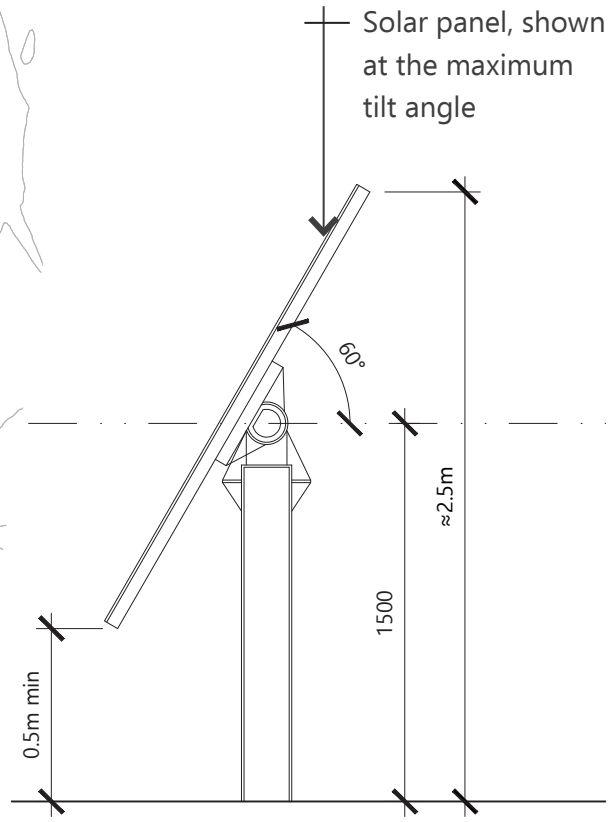


Figure 3.2: Solar panel on the tracking system

4. Visual impact assessment

4.1. Viewpoint Analysis

This section of the visual assessment considers the likely impact that the proposed development may have on the views toward the site. This is done by identifying and selecting particular sites, referred to as viewpoints, conducting inspections and determining what part of the development will be visible from those viewpoints and the visual impact of that development proposal.

The viewpoints, as shown on Figure 2.4, were selected on the basis of where the development would appear to be most prominent either based on degree of exposure or the number of people likely to be affected. Sites were further selected on the basis of significant features, significant viewpoints and significant ridge lines.

The following viewpoint worksheets provide photographs and analysis data from each of the viewpoints. The images were taken using a digital camera with a focal length equal to a standard 50mm for a conventional 35mm camera. This focal length is widely accepted as closely approximating the vision of the human eye.

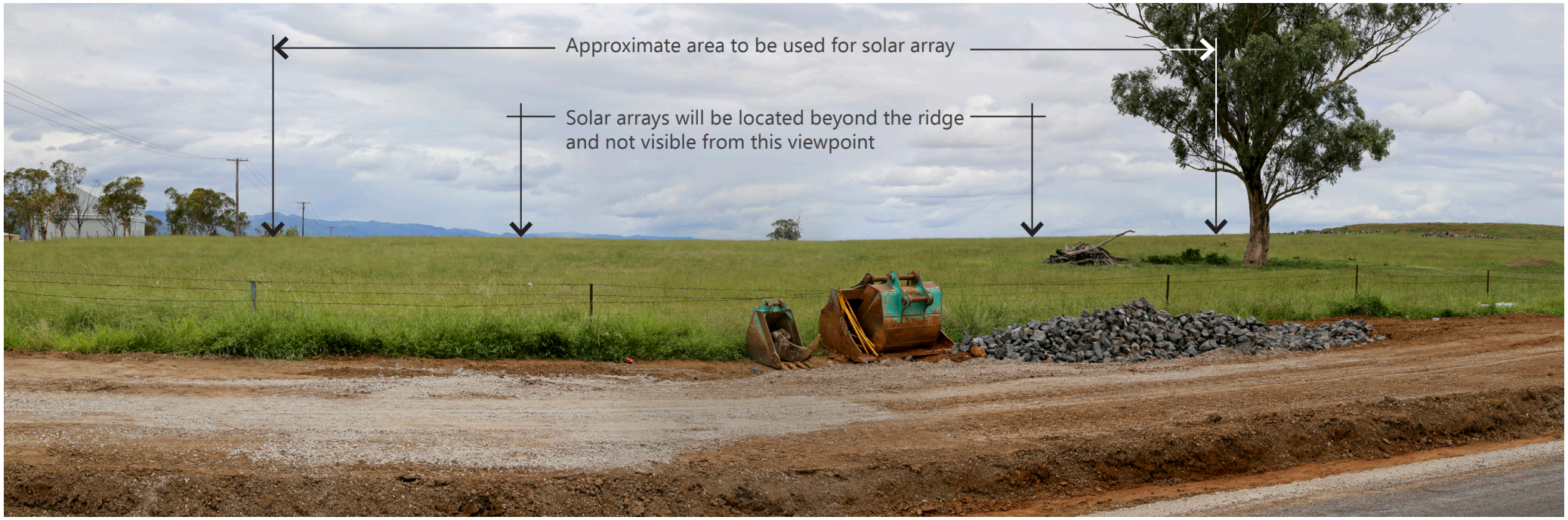
4.1.1. Site Visit

A two-day site visit was undertaken on 10 and 11 February 2020 by a registered landscape architect and environmental planner who has substantial experience analysing and mitigating visual impacts on the landscape.

During the site visit, viewpoints were confirmed and an assessment was made of each potential representative public viewpoint against the extent of the solar farm project.

At the time of the site visit, the area was experiencing intermittent rain showers. However, the photographs were captured when visibility was good and rain was not falling on site.

Viewpoint 1

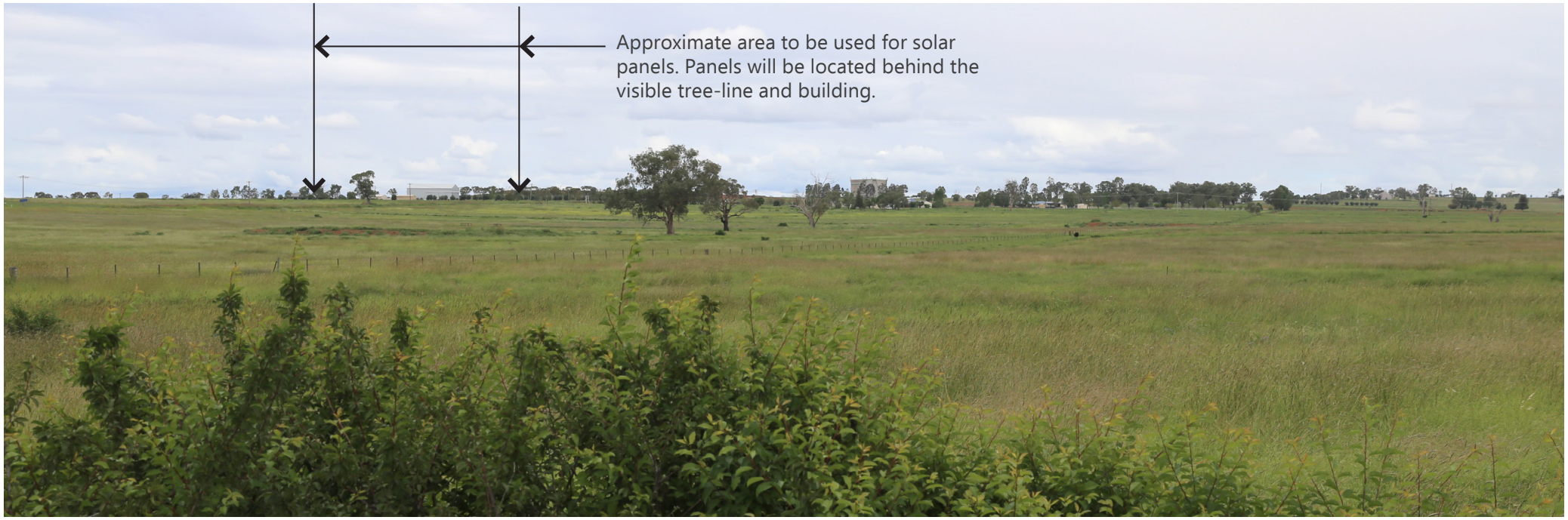


Viewpoint 1	Country Road, Westdale
Viewing situation	Immediately adjacent to the site facing west
Category of view	Immediate vicinity
Context of view	Panoramic view from roadway adjacent to site
Relative number of viewers	Low
Distance of view	230m
Likely period of view	Low (traffic)
Visibility	Low
Visual absorption capacity	Medium
Visual impact rating	Low

Description:
View from Country Road adjacent to the site looking east toward the proposed development.

Comments:
This is the location of the proposed entry road. There will be a new driveway from this location and the screening trees/shrubs will be visible from here.

Viewpoint 2



Viewpoint 2	32 New Winton Road, Westdale
Viewing situation	Same elevation as the site
Category of view	Local Area
Context of view	From roadway north of site
Relative number of viewers	Low
Distance of view	1.6km
Likely period of view	Low (traffic)
Visibility	Low
Visual absorption capacity	High
Visual impact rating	Low

Description:
View from the New Winton Road, north of the site looking toward the proposed development.

Comments:
This is the view available from the Tamworth airport area and along Oxley Hwy. There are residences with this view. This view is also available from the adjacent roads and will typically be seen from a moving vehicle.

From this direction, the solar arrays will be below the ridgeline and behind the row of trees that is visible.

Viewpoint 3



Viewpoint 3	29 Flemming Crescent, West Tamworth
Viewing situation	On slope below the site
Category of view	Immediate vicinity
Context of view	From roadway east of site
Relative number of viewers	Medium
Distance of view	1.5km
Likely period of view	Low (traffic) Long (residents)
Visibility	Moderate
Visual absorption capacity	Medium
Visual impact rating	Moderate

Description:
View from a residential road east of the site looking toward the proposed development.

Comments:
The entire width of the site is visible from this direction. However, there is a row of trees along the eastern boundary of the development that will screen most of the solar arrays from view.

This view is from the edge of the existing residential community, so there are residences along the road that share this view.

Viewpoint 4



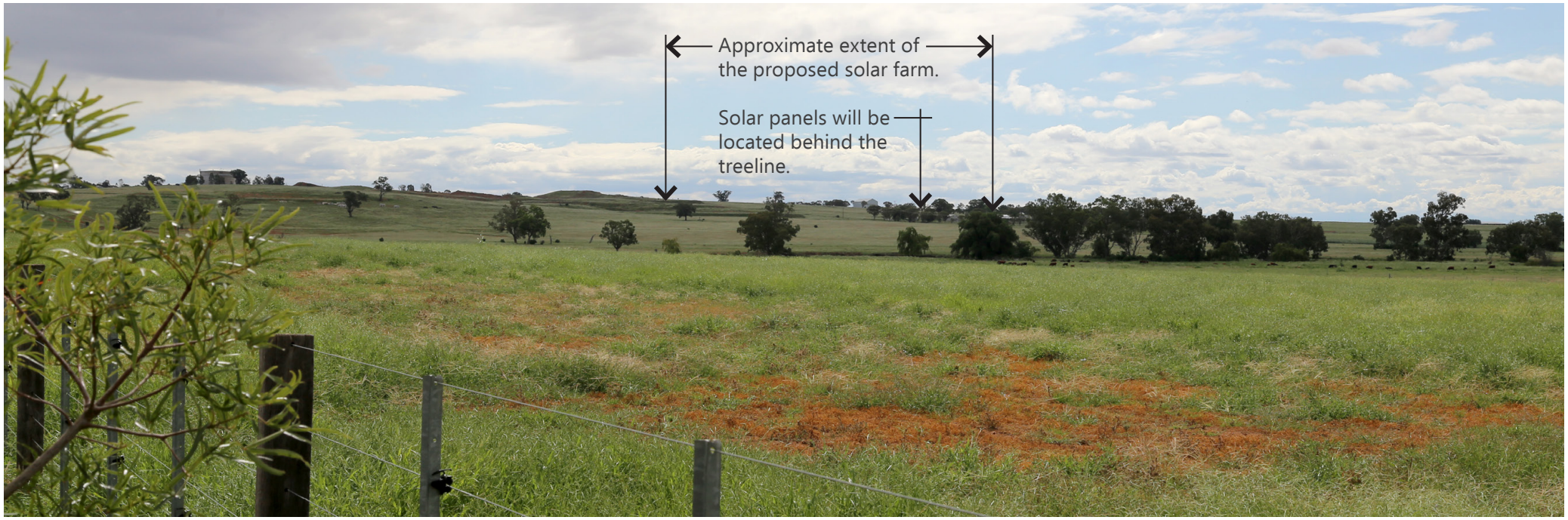
Viewpoint 4	Cnr Gunnedah Road and Cole Road, Taminda
Viewing situation	Lower and across a small valley
Category of view	Local area
Context of view	From roadway at an elevated location
Relative number of viewers	Low
Distance of view	2.1km
Likely period of view	Low (traffic) Long (residents along the road)
Visibility	Moderate
Visual absorption capacity	High
Visual impact rating	Low

Description:
View from Gunnedah Road intersection with Cole Road. The view is from the north east of the site looking toward the proposed development.

Comments:
This is the initial location from which the solar farm will be visible when travelling from Tamworth toward the airport.

There are businesses and residences along this road who may share this view. In this particular location the road rises up over a rise, which allows views like this across the valley. Otherwise the road travels along the bottom of the valley with trees and structures blocking views to the development site.

Viewpoint 5



Viewpoint 5	300 Warral Road, Warral
Viewing situation	Slightly lower than the site, looking across paddocks
Category of view	Local area
Context of view	From a residential driveway
Relative number of viewers	High (from roadways) Low (residences)
Distance of view	1.8km
Likely period of view	Low (traffic) Long (residents)
Visibility	Moderate
Visual absorption capacity	Medium
Visual impact rating	Moderate

Description:
View from the east, below the site.

Comments:
There are scattered residences along the slopes below the development site. This represents the typical view from those residences.

Warral Road, the railway and Duri Road run parallel to each other at this location, so people in vehicles and railway cars will share this view.

Viewpoint 6



Viewpoint 6	3 Barreng Street, Hillvue
Viewing situation	Similar elevation, across a valley
Category of view	Local area / Regional area
Context of view	Across the valley from a residential community
Relative number of viewers	Low
Distance of view	3.0km
Likely period of view	Long (residents along this hillside)
Visibility	Low
Visual absorption capacity	High
Visual impact rating	Low

Description:
View from across the valley.

Comments:
There are very few vantage points from which to view the development site. This view illustrates the difficulty in seeing the site from any distance as there are multiple tree-lines and structures and topographic visual barriers.

This represents the best viewing location from the west. This area is on a west facing slope directly opposite the solar farm site and therefore has the best veiwing potential.

Viewpoint 7



Viewpoint 7	21 Ventnor Drive, North Tamworth
Viewing situation	Elevated looking over the valley
Category of view	Regional area
Context of view	Across the valley from a hilltop lookout point
Relative number of viewers	Low
Distance of view	6.5km
Likely period of view	Low (traffic) Long (residents along the road)
Visibility	Low
Visual absorption capacity	High
Visual impact rating	Low

Description:
View from the furthest distance from which the site is visible. It looks across a valley with grassy paddocks and clumps of intermittent trees. The solar farm site is on the distant slopes across the valley.

Comments:
This represents the furthest location from which the site may be visible with correct atmospheric conditions.

The solar panels will be behind trees that will screen the development from view.

4.2. Visual impact assessment summary

This section of the report summarises the findings of the visual impact assessment of views in the immediate vicinity, local views and regional views of the site.

4.2.1. Views from the immediate vicinity (< 1.5km)

The proposed development is likely to have a high visual impact from the buildings and residences immediately to the north (one property) and east (two properties) of the proposed development. The visual impact is primarily due to the close proximity. Additionally, the rectilinear forms and rigid linear arrangement of the solar panels contrasts with the surrounding natural forms.

Beyond the structures adjacent the development, views of the site tend to be screened by the trees and buildings along the north and east boundaries.

The only road near the solar farm is Country Road. Even though this is where the access to the site will be, the ridgeline running between the road and the solar arrays will block views from Country Road and further west.

4.2.2. Local views (1.5 – 3km)

The proposed development is most visible from this distance. Most views are from the east, but some views from the north and southeast are available. This occurs because the site slopes down toward the east.

As illustrated in the photographs, there are trees along the northern and eastern boundaries (outside of the site). These trees provide visual screening to the lower portion of the development.

The visual impact is low to medium from this distance. The site is visible to a larger number of viewers, but these views are distant, screened and partially obstructed.

4.2.3. Regional Views (3 – 6km)

Regional views occur from the east and north of the site. These views are from across a valley and over the mass of rooftops that form suburbs of Tamworth.

Where views are available, the solar arrays will generally blend in with the rooftops or will be screened by vegetation.

The visual impact from this distance is low.

5. Photomontages

5.1. Photomontage development

A photomontage is a visualisation based on superimposing an image (of proposed development) onto a photograph. Its purpose is to simulate a realistic representation of proposed or potential changes to a view (Horner and Maclennan et al, 2006). The photomontages used in this VIA are to assist in the assessment of the impacts from the proposed development.

5.1.1. Photomontage development process

Since a photomontage is a representation of the development superimposed on a photograph, an image of the proposal must be developed. This is done as a digital model of the solar panels and structures. The digital model is then captured from the perspective of the photograph, and then superimposed on it.

In these photomontages, the solar panels are shown at their maximum height to simulate a worst-case scenario.

5.1.2. Selection process

The photomontages selected represent key views to demonstrate the visibility of the proposed solar farm within the existing context. Photomontages have been prepared for Viewpoint 3, Viewpoint 4 and Viewpoint 6. These viewpoints illustrate the general visibility of the site from locations of the highest visibility and the highest number of viewers.

Photomontage 1 - Viewpoint 3



Existing view



Existing view with proposed solar farm development. This photomontage shows the affect of the solar panels on the landscape from this vantage point without any additional plant screening.

Photomontage 2 - Viewpoint 4



Existing view



Existing view with proposed solar farm development. This photomontage shows the affect of the solar panels on the landscape from this vantage point.

Photomontage 3 - Viewpoint 6



Existing view



Existing view with proposed solar farm development. This photomontage shows the affect of the solar panels on the landscape from this vantage point.

6. Glare Analysis

When sunlight is reflected off a smooth surface, it can result in glint or glare. Glint is a quick reflection or flash of light, while glare is experience for a longer period of time. Both of these can be annoying and dangerous in certain situations.

6.1. Angle of reflection

The angle of reflection of light off a reflective surface is directly related to the angle of incidence of the light from the source (see Figure 6.1 and 6.2). In the case of a solar array, the sunlight will reflect off the panel at the same angle as it arrives from the sun. If the panel is stationary, the sun's angle relative to the solar panel will vary by time of day and therefore reflect toward the west in the morning and eastward in the evening.

The proposed solar arrays will track the sun's movement across the sky. As a result, reflections will be directed upward and away from any ground-based viewers. Geometrically, the lowest angle of reflection will be 30° above the horizon line.

The seasonal change of the sun's movements will vary the refection angles as well. As the sun move southward in the summer months, the reflection will move northward, and vice versa in the winter months (when the sun is north of the equator). While this movement changes the reflection angle in a north-south direction, the reflection angle will not fall below 30° above the horizon line.

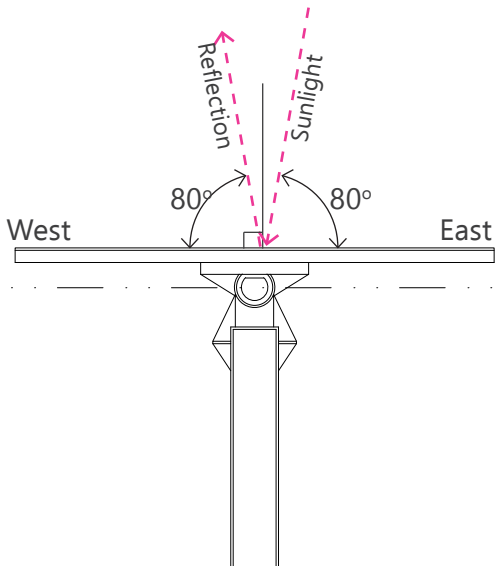


Figure 6.1: Typical reflection and glare angles during the day.

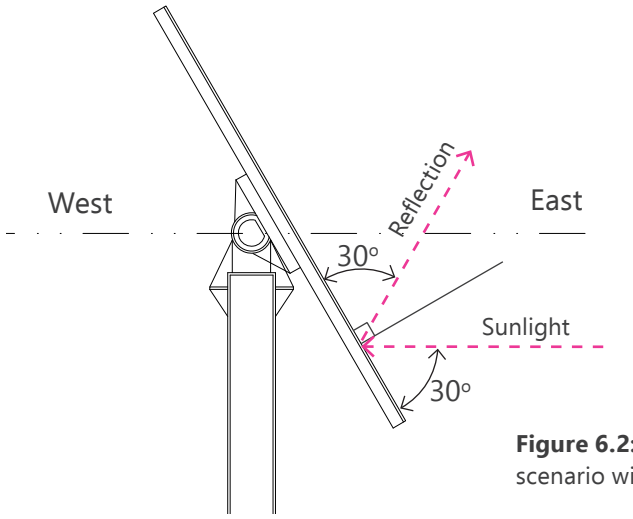


Figure 6.2: Typical sunrise/sunset reflection scenario with direction of reflection and glare.

6.2. Reflectivity

Solar cells are designed to absorb light energy to create electrical currents. As such, they will only reflect a portion of the sunlight that falls on them.

Generally, the light reflected is diminished by first hitting the substrate that reflected it. Typically, solar panels are constructed from a treated glass that is designed to minimise reflection and maximise the amount of light transmitted through the glass to the receptor. Typical treated glass that is used for solar cells reflects about 4% of the light that hits the cell. This is equivallent to a water body (pond or lake), which is considered to be a fairly low amount of reflection.

6.3. Analysis

By knowing the characteristics of reflected light, we can determine where glare is likely to be an issue. In the case of the Tamworth solar farm, trackers will be used to maximise the sunlight absorbed by the cells. The trackers are designed to keep the panel perpendicular to the sun. We can therefore assume that the sunlight reflected will reflect perpendicular to the cell and directly back toward the sun. At times when the tracking system has reached the limit of its tracking range, the angle of incidence moves from perpendicular and the light that is reflected is expected to reflect up and away from the ground. Given that the tracking stops when the panel is 60° from horizontal, the refection will be at a minimum of 30° above the horizon.

Given the parameters of reflection and the movement of the solar panels, there are no locations surrounding the site where glint or glare are geometrically possible.



Image: Example of similar solar panels from adjacent roadway



Image: Example of similar solar panels viewed from close proximity

7. Visual mitigation measures

7.1. Recommendations

The visual impact assessment in Section 4 of this report assigns either a high, medium or low visual impact rating when viewed from the immediate vicinity, local views and regional views. The following mitigation measures should be considered in the design and assessment of the proposed development.

Visual character

To maintain the visual character of the area around the site, the following recommendations are suggested.

- The solar array site and immediate surrounds contain a number of existing trees and shrubs that should be retained
- Trees and large shrubs can be planted along the north and eastern boundaries to screen views from those directions
- Trees planted within the site (along the boundaries) should be selected for their size and ability to blend into the existing trees
- Placement of the trees should maximise visual screening while allowing unobstructed sunlight to reach the solar panels
- Since the solar panels will reach approximately 1.5m in height, large shrubs may be more appropriate for screening.

Built form, materials and colours

- Materials, textures and colour selection should relate to the palette of the surrounding environment to minimise visibility and potential for visual impact
- Bright and contrasting colours should be avoided
- Solar panels should use anti-reflective coatings
- Consideration should be given to controlling the type and height of PCU's storage sheds to ensure the development does not contrast significantly with the surrounding landscape.

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Flora and Fauna Assessment Report



KDC Pty LTD

Tamworth Solar Farm

Country Road, Westdale NSW (Lot 211 DP 1069964)

07 April 2020

Flora and Fauna Assessment Report

Tamworth Solar Farm

Country Road, Westdale NSW (Lot 211 DP 1069964)

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KDC PTY LTD

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1. INTRODUCTION

1.1 PROJECT BACKGROUND

Kleinfelder were engaged by KDC Pty Ltd (KDC) on behalf of Providence Investment Management Pty Ltd (Providence Asset Group) to prepare a Flora and Fauna Assessment Report for a proposed solar farm located at Lot 211 DP 1069964 Country Road, Tamworth NSW (**Figure 1**). The project will be assessed under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) with Tamworth Regional Council as the determining authority.

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

- Study area – Lot 211 DP 1069964 (59 ha).
- Subject site (development footprint) – areas of the study area proposed for development.
- Locality – land within a 5 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 approximately 1.5 km southwest of the township of Tamworth within the Tamworth Regional Council Local Government Area (LGA) and is zoned 'RU4 – Primary Production Small Lots' under the Tamworth Local Environmental Plan (Tamworth LEP, 2010).

The eastern boundary of the study area is bordered by Country Road. The northern and eastern boundaries are bordered by an unnamed access road to a rural dwelling to the east. A quarry occurs on the lands directly to the south. The predominant land use within the locality is agricultural development.

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The topography is relatively flat with an elevation ranging from 400-435m. A first order stream flows through the northern portion of the study area in a northeast direction toward Timbumburi Creek, which occurs approximately 1.2 km to the east.

No natural waterbodies occur within the study area; however, a large constructed dam occurs within the quarry area to the south. Four first order stream flow into this dam and one second order stream flows from the dam toward Timbumburi Creek to the northeast.

The subject site has previously been cleared of native vegetation for agricultural development (i.e. grazing) and for the quarry. Remaining native vegetation consists of areas of native/exotic grassland and isolated mature trees.

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

1.3 PROPOSED DEVELOPMENT

The Tamworth Solar Farm Project will include a 5 MW grid-connected solar PV installation. The proposed project layout is provided in **Figure 3**.

Access will be achieved via Country Road, which will lead into the car park area and the off-load area. The proposed laydown area (manoeuvring area) will be located midway along the southern boundary of the site via an internal access road from the site entrance. This area will also provide space for car parking and a prefabricated unit drop off area during the construction phase. The solar panels will be enclosed by a 1.8 m security fence with security gates for access.

1.4 REPORT OBJECTIVES

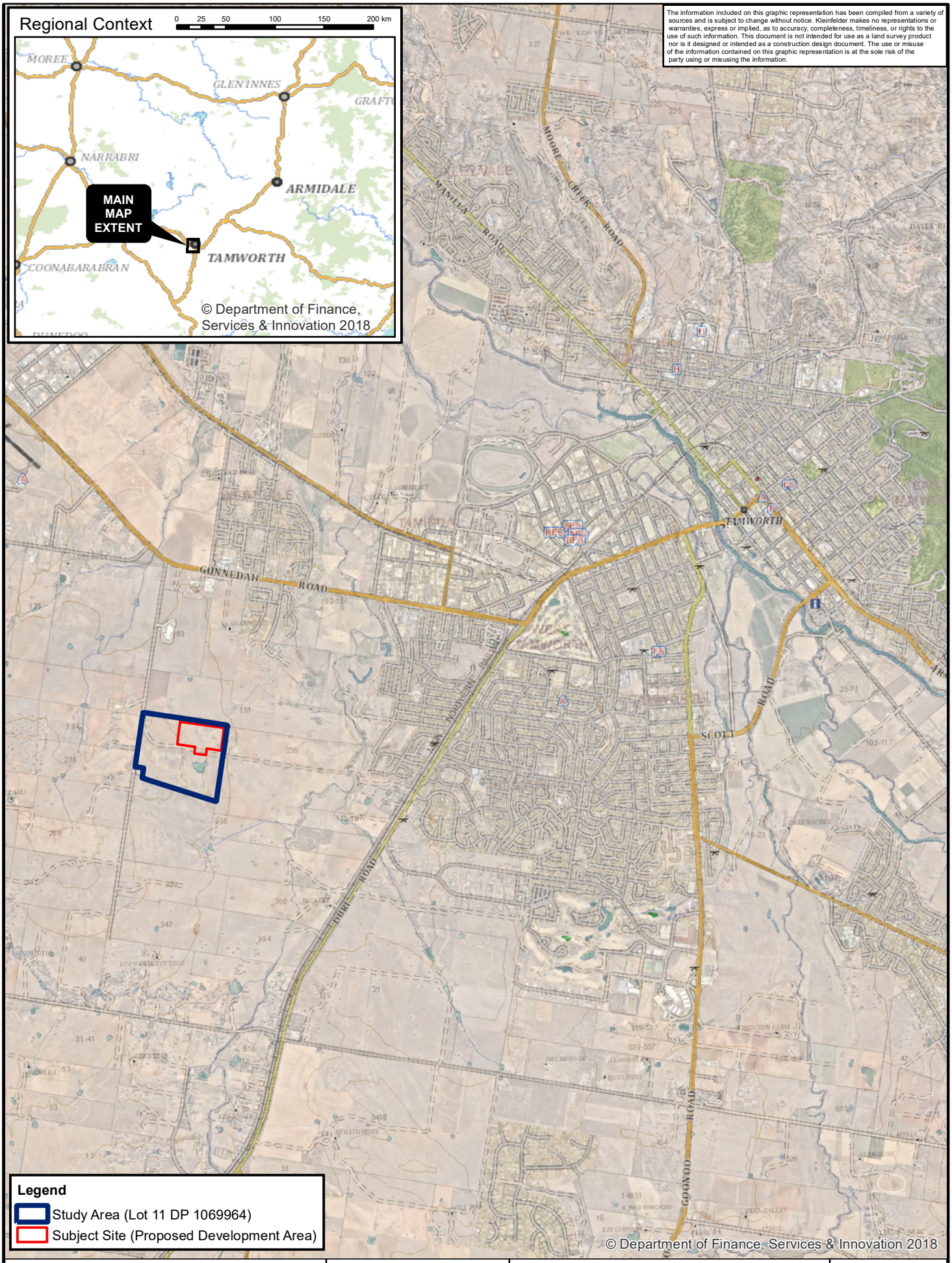
The objectives of the Flora and Fauna Assessment Report include:

- 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).

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- 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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DATA SOURCE:
NSW DFSI - 2018
NSW OEH - 2019

Locality

KDC Pty Ltd
Flora & Fauna Assessment
South Tamworth Solar Farm

FIGURE:

1

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NSW OEH - 2019
Nearmap - 2020

Study Area and Subject Site

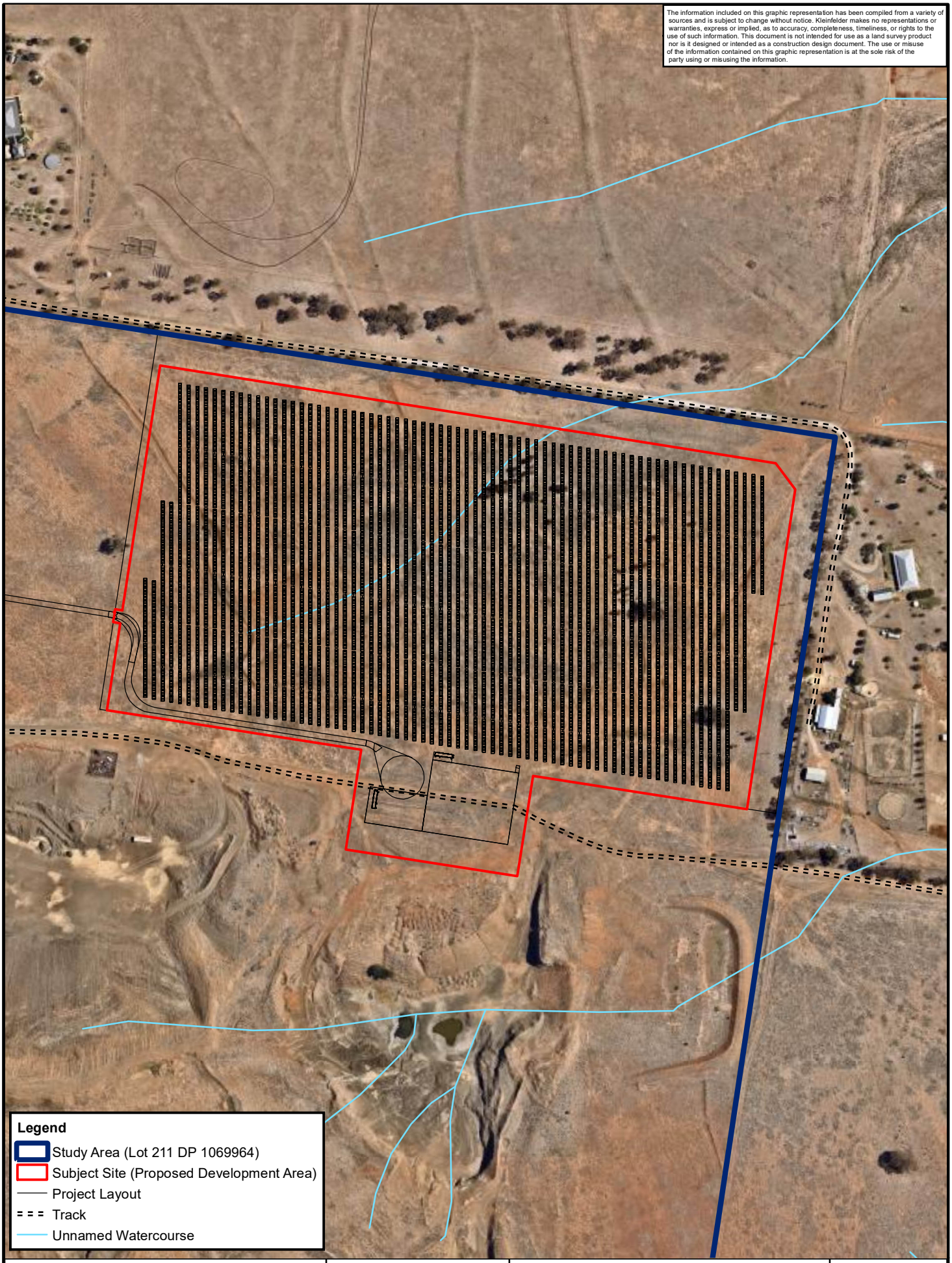
KDC Pty Ltd
Flora & Fauna Assessment
South Tamworth Solar Farm

FIGURE:

2

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DATA SOURCE:
KDC - 2020
NSW DFSI - 2018
NSW OEH - 2019
Nearmap - 2020

Proposed Site Layout

KDC Pty Ltd
Flora & Fauna Assessment
South Tamworth Solar Farm

FIGURE:

3

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2. LEGISLATIVE CONTEXT

2.1 COMMONWEALTH 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.

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- 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 Tamworth Regional 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.

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- 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 not involve clearing of native vegetation that exceeds the BOS threshold for the site (1 ha threshold for a minimum lot size of 40 ha) as determined by the NSW *Biodiversity Conservation Regulation 2017*.

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 5 km buffer) were obtained from the on-line BioNet Atlas of NSW Wildlife (DPIE, 2020a). These records are discussed in **Section 4** of this report. 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 subject site during the current investigation are discussed in **Section 4**.

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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.

One watercourse is mapped the subject site (**Figure 2**). Notwithstanding the application of the WM Act, 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.

The Koala Habitat Protection SEPP is applicable to the proposed development due to the following:

- Tamworth Regional Council LGA is listed under Schedule 1 of the SEPP (Koala Habitat Protection) 2019.

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- The proposed development will require the removal of White Box *Eucalyptus albens,* which is listed as a preferred Koala feed tree under Schedule 2 of the SEPP (Koala Habitat Protection) 2019.
- Review of the SEPP spatial viewer indicates that areas of the study are mapped by the Site Investigation Area for Koala Plans of Management Map.
- The study area is greater than 1 hectare (ha)

A Koala Plan of Management (KPoM) has not been prepared for the study area; therefore, provisions of Clause 9 of the SEPP (Koala Habitat Protection) is applicable to the proposed development. As such, Council must take into account the requirements of the Koala Habitat Assessment Guideline (DPIE, 2020b), or information prepared by a suitably qualified and experienced person in accordance with the guideline to determine if the land is classified as Highly Suitable Koala Habitat or Core Koala Habitat.

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

2.3 LOCAL PLANNING INSTRUMENTS

2.3.1 Tamworth Local Environmental Plan 2010

The study area is located within the Tamworth Regional Council LGA. The Tamworth Local Environmental Plan 2010 (Tamworth LEP, 2010) controls development within the study area through zoning and development controls. These controls are described in greater detail by the supporting Tamworth Development Control Plan (Tamworth DCP, 2010).

2.3.2 Tamworth Regional Development Control Plan 2010

The Tamworth DCP supports the Tamworth LEP by providing additional detail and guidance on addressing biodiversity issues associated with development. In regard to biodiversity, the DCP contains provisions that relate to environmental effects, soil and erosion control and vegetation. These provisions have been considered during the assessment.

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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: Extant natural vegetation for Cobbadah, Manilla and Tamworth (VIS_ID 3796) (DPIE, 2009).
- 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 23/03/2020).
- 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 23/03/2020).
- 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 inspection of the subject site and surrounds was undertaken on 04 March 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.

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

Four 400 m² floristic plot/transects were 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.

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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. An Anabat Express detectors (Titley Scientific) was deployed for one night in the central portion 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

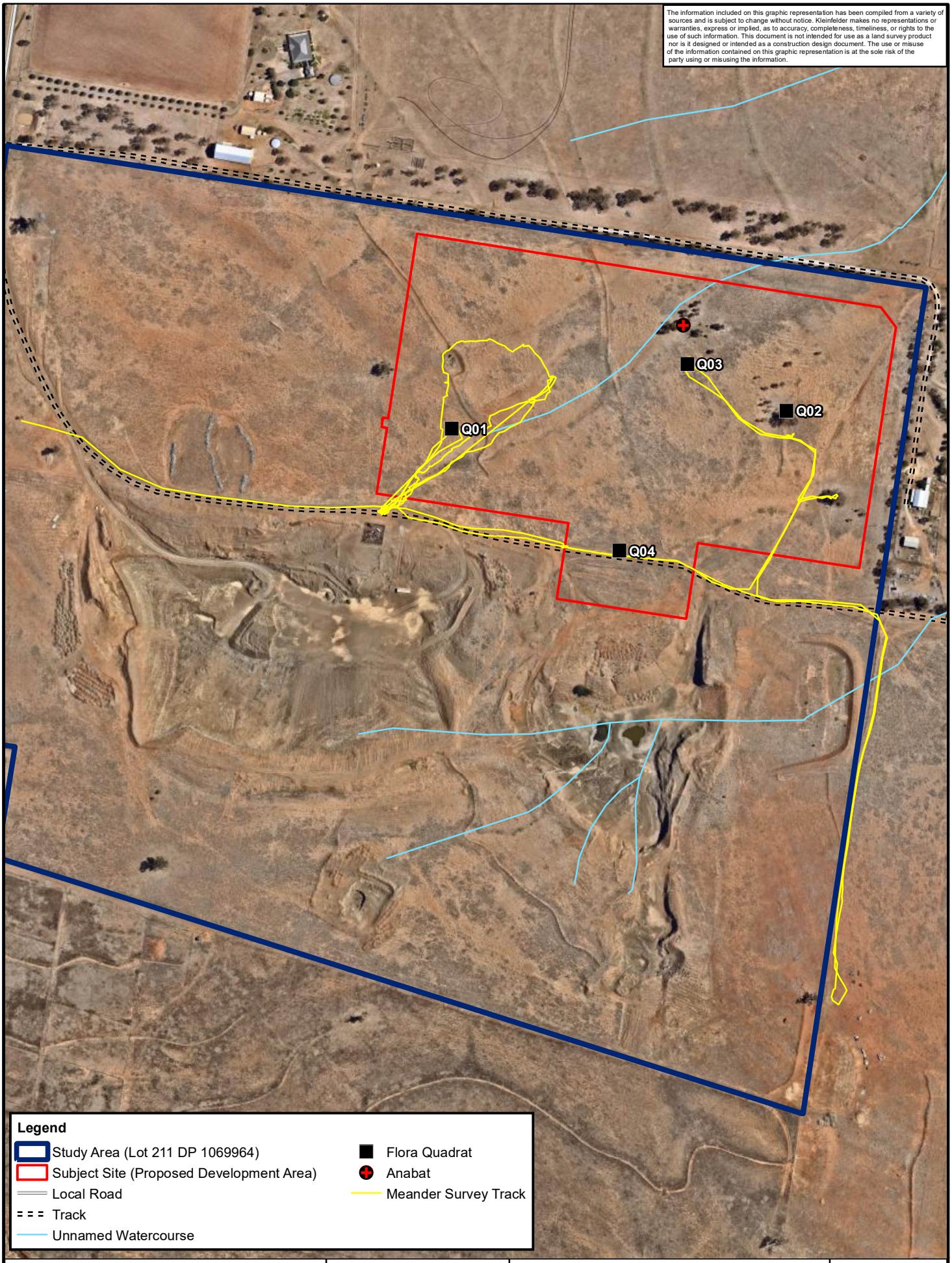
The survey techniques and survey effort applied for this study were commensurate with the nature and condition of the subject site. Due to these limitations, priority was given to habitat assessment for relevant threatened biota. A 'likelihood of occurrence' assessment was applied to all species previously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

The field survey was undertaken during a six-hour survey period by two ecologists (12 person hours total). While a moderate diversity of native and exotic flora species was 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 near the bases of trees.

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 211 DP 1069964)
- Subject Site (Proposed Development Area)
- Local Road
- Track
- Unnamed Watercourse
- Flora Quadrat
- Anabat
- Meander Survey Track

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DATA SOURCE:
KDC - 2020
NSW DFSI - 2018
NSW OEH - 2019
Nearmap - 2020

Survey Effort

KDC Pty Ltd
Flora & Fauna Assessment
South Tamworth Solar Farm

FIGURE:

4

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4. RESULTS

4.1 PLANT DIVERSITY

A total of 58 plant species were identified during the assessment. These were comprised of 26 exotics and 32 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 grasslands. Native plant species were comprised mainly of grasses.

One tree species (White Box *Eucalyptus albens*) were detected within the subject site.

4.2 WEEDS

No major infestations of priority weeds (DPI, 2020) or Weeds of National Significance (DoEE, 2020c) were identified. Minor infestations of weeds were identified, including the following species:

- African Love Grass *Eragrostis curvula.*
- African Box Thorn *Lycium ferocissimum*
- Bathurst Burr *Xanthium spinosum*

Mitigation measures to prevent the spread of weeds are presented in **Section 5.2.**

4.3 PLANT COMMUNITY TYPES

Discussions with Council indicate that the subject site has a history of being grazed by livestock. The regional vegetation mapping (DPIE, 2009) indicates that the majority of the subject site is comprised of Plains Grass grassland of the Brigalow Belt South and Nandewar Bioregions (PCT 31). The quarry area to the south is mapped as “Urban and Cropping”.

The assessment revealed that the entirety of the subject site is comprised of exotic/ native grassland (**Figure 5**). Floristic plot data indicates that the dominant grass species is Great Brome *Bromus diandrus*. This introduced grass species had a projected ground cover of

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approximately 20% throughout the project site. Other dominant exotic plant species included the following:

- Fishweed *Einadia trigonos*
- Liverseed Grass *Urochloa panicoides*
- Stinkgrass *Eragrostis cilianensis*
- Fat Hen *Chenopodium album*
- Crowsfoot Grass *Eleusine indica*

Native grass species within the subject site comprise the following species:

- Queensland Bluegrass *Dicanthium sericeum*
- Slender Nineawn *Enneapogon gracilis*
- Purple Wiregrass *Aristida ramosa*

Isolated mature native trees (White Box *Eucalyptus albens*) were detected within the subject site (**Appendix 1**). These trees are likely to be relicts of a woodland community previously widespread within the locality such as *White Box Yellow Box Blakely's Redgum Woodland.*

4.4 THREATENED ECOLOGICAL COMMUNITIES

The presence of White Box *Eucalyptus albens* within the subject site indicates that prior to being cleared and grazed, the area was likely to contain *White Box Yellow Box Blakely's Redgum Woodland*, which is listed as an 'Endangered Ecological Community (EEC)' under the BC Act. In accordance with the Scientific Determination for the EEC (NSW Scientific Committee, 2011) "*Disturbed remnants are still considered to form part of the community including remnants where the vegetation, either understorey, overstorey or both, would, under appropriate management, respond to assisted natural regeneration, such as where the natural soil and associated seed bank are still at least partially intact*".

The grasslands within the subject site are dominated by exotic grasses and are considered to be too degraded to represent derived native grasslands of *White Box Yellow Box Blakely's Redgum Woodland*. Due to the low diversity of native grasses and herbs present, it is unlikely that the grasslands would respond to assisted natural regeneration. The subject site does not adjoin any areas of better-quality habitat that would allow natural colonisation of native grasses and herbs. Many of the exotic grasses and herbs present are aggressive weeds that are difficult to eradicate without the use of herbicides.

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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 one record of a threatened plant species within a 10km radius of the study area: Magenta Lily Pily (*Syzygium paniculatum*). A "likelihood of occurrence" assessment determined that habitat for this species does not occur within the subject site (**Appendix 3**).

An EPBC Protected Matters Search returned a list of seven threatened plant species predicted to occur within the locality of the subject site. A "likelihood of occurrence' assessment determined that habitat is present within the subject site for Bluegrass *Dicanthium setosum.* This grass species occurs on the New England Tablelands, North West Slopes and Plains and the Central Western Slopes of NSW, extending to northern Queensland. The species is mainly 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 The species is often collected from disturbed open grassy woodlands on the northern tablelands, where the habitat has been variously grazed, nutrient-enriched and water-enriched (DPIE, 2020c).

The potential for impacts to Bluegrass have been assessed via an 'assessment of significance' pursuant to Section 7.3 of the BC Act in **Appendix 5**.

4.6 FAUNA HABITAT

The assessment revealed that the vegetation within the subject site is comprised mainly of grassland with occasional scattered trees (White Box *Eucalyptus albens*). At the time of the assessment, the grasslands were tall and dense due to recent rainfall (i.e. greater than average summer rainfall). Leaf-litter and woody debris was generally absent having been pushed into windrows near the site entrance.

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. In summary, the fauna habitat assessment determined the following:

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- The isolated mature trees within the subject site may provide marginal foraging and nesting habitat for several common native bird species.
- The 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 may provide refuge habitat for fauna groups such as amphibians, reptiles and small mammals.
- The grasslands may provide hunting habitat for native predatory birds, such as Falcons, Kestrels and Large Forest Owls.
- Three hollow-bearing trees were identified within the subject site. These hollows were inspected from the ground and were identified as being suitable nesting habitat for smaller birds such as parrots or roosting habitat for microchiropteran bats.

4.7 FAUNA SPECIES

Opportunistic fauna observations included sightings of common bird species such as the Australian Magpie and the Noisy Miner. No reptile or amphibian species were detected. Microbat species detected via Anabat included the following:

- Gould's Wattled Bat *Chalinolobus gouldii*
- Southern Free-tailed Bat *Mormopterus planiceps*
- Inland Free-tailed Bat *Mormopterus petersii*
- Eastern Free-tailed Bat *Mormopterus ridei*
- Inland Broad-nosed Bat *Scotorepens balstoni*
- Little Forest Bat *Vespadelus vulturnus*

4.8 THREATENED FAUNA SPECIES

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 six threatened fauna species that have previously been recorded within 5 km of the subject site:

- Square-tailed Kite *Lophoictinia isura*
- Black Falcon *Falco subniger*
- Little Lorikeet *Glossopsitta pusilla*
- Spotted-tailed Quoll *Dasyurus maculatus*
- Koala *Phascolarctos cinereus*

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- Grey-headed Flying-fox.

A “likelihood of occurrence” assessment determined that the habitat is too degraded and does not contain suitable habitat to support populations of any of these species (**Appendix 3**)

4.9 KOALA HABITAT

Most of the subject site has been cleared for agricultural development. Isolated mature trees were found to be comprised of White Box *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:

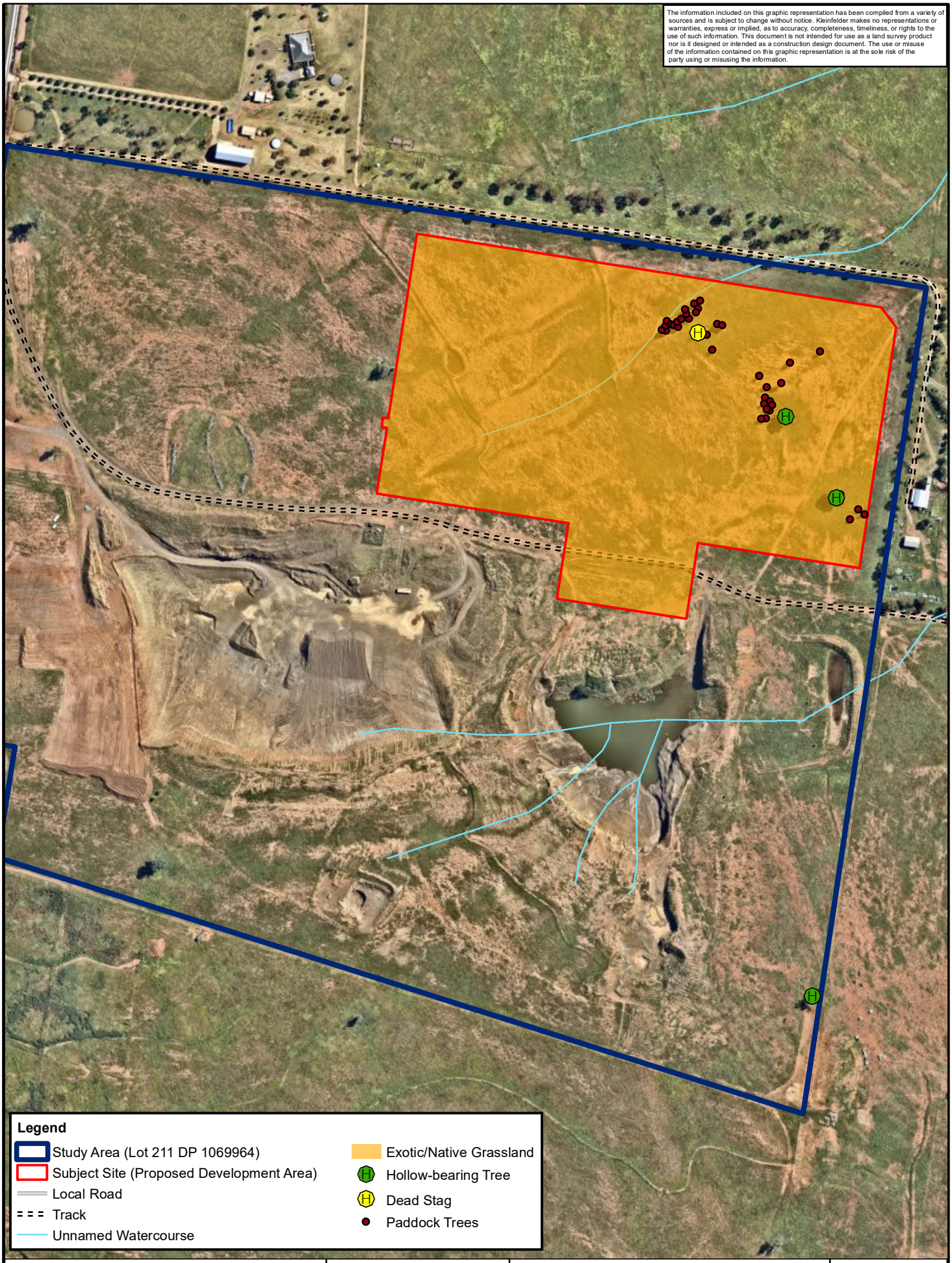
- No evidence of a resident population of Koalas was detected during the assessment (i.e. No Koala individuals, scats or scratch marks were identified).
- The Koala feed trees within the subject site are isolated in the landscape and are therefore unlikely to be fed upon by Koalas.
- Only one historical record of a Koala occurs within 5 km of the study area (DPIE, 2020a).

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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PROJECT REFERENCE: 20203963

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DRAWN BY: GJoyce

DATA SOURCE:
KDC - 2020
NSW DFSI - 2018
NSW OEH - 2019
Nearmap - 2020

Vegetation and Habitat Features

KDC Pty Ltd
Flora & Fauna Assessment
South Tamworth Solar Farm

FIGURE:

5

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5. DISCUSSION

5.1 IMPACT ASSESSMENT

5.1.1 Removal of Native Vegetation

Removal of native vegetation within the subject site will be limited to the removal of native groundcover and isolated mature trees and shrubs (i.e. 37 trees and shrubs total, including three hollow-bearing trees) (see **Figure 5**). The trees and shrubs to be removed may represent foraging and nesting habitat for a range of fauna groups. Mitigation measures to manage the potential displacement of fauna species are presented in **Section 5.2.**

5.1.2 Impacts to Fauna

Potential indirect impacts of the proposed development on resident fauna populations include the following:

- Noise and lighting during the construction phase may cause minor disturbance to resident fauna within the locality and disrupt their natural behaviour.
- 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 the constructed dams and downstream aquatic habitat.

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

5.1.3 Impacts to Threatened Species

No threatened species were identified during the assessment. A “likelihood of occurrence” assessment determined that habitat occurs within the subject site for Bluegrass *Dicanthium setosum*. In accordance with Section 7.3 of the BC Act, an ‘assessment of significance’ determined that the proposed development is unlikely to have a significant impact on this species.

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5.1.4 Impacts to Threatened Ecological Communities

No TECs were identified within the subject site. The number of trees within the site are too few for the woody vegetation to represent woodland vegetation and the grasslands are considered too degraded to represent derived native grasslands of *White Box Yellow Box Blakely's Redgum Woodland EEC.*

5.1.5 Impacts to Aquatic Habitat

The proposed development has been designed to avoid directly impacting the mapped waterways within the study area. 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.**

5.1.6 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 few mature trees will be removed within the study area.

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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 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 Clearing (Tree Removal)

The following recommendations are to be implemented during vegetation clearing:

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- A suitably trained Ecologist should be present onsite to supervise vegetation clearing activities and manage displaced fauna species.
- Areas of vegetation outside the development footprint are to be clearly demarcated to prevent accidental clearing during the construction phase.
- Vegetation should be cleared in a way that will allow fauna species living in or near the clearing site enough time to move out of the area without additional human intervention.
- No clearing should occur during the early evening or at night.
- The direction of clearing should also ensure that fauna species are directed away from threats such as roads.

5.2.2.5 Management of Displaced Fauna

The following recommendations apply to the management of any displaced fauna species during vegetation clearing activities:

- All handling of fauna species should be conducted by a suitably trained Ecologist.
- Displaced fauna species are to be relocated to adjacent bushland.
- Nocturnal fauna species, such as microbats, are to be 'soft released' using bat boxes placed in adjacent habitat.
- Nocturnal fauna species, such as gliders and possums, are to be secured in suitable enclosures and kept in a quiet, dark and cool environment until they can be released into suitable habitat after dark.
- If any injured fauna species are found during the construction period, construction must stop immediately so that the injured animal is to be taken to a vet or wildlife carer.

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 mainly affect areas of exotic/native grassland (agricultural land) and will require the removal isolated mature trees within the subject site. These trees are not considered to be important habitat for the long-term survival of threatened species within the locality. The proposed development is unlikely to cause a significant impact to any

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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, ecological communities, 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: **Exotic/ native Grassland within the subject site.**



Plate 2: **Isolated White Box (*Eucalyptus albens*) with shrubby regrowth around the base**

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APPENDIX 2: FLORA SPECIES LIST

Table 1: Flora List

Growth Form	Plant Species	Plot 1		Plot 2		Plot 3		Plot 4	
		Cov.	Ab.	Cov.	Ab.	Cov.	Ab.	Cov.	Ab.
Exotic Herb	*Amaranthus sp.*						0.1	1	
Native Grass	*Aristida ramosa*			1	100	20	10000	5	500
Native Grass	*Aristida vagans*					0.1	20		
Native Grass	*Austrostipa sp.*	0.25	100						
Native Grass	*Austrostipa verticillata*			10	500				
Native Forb	*Boerhavia dominii*	2	200			2	500	2	50
Native Grass	*Bothriochloa macra*								
Exotic Grass	*Bromus diandrus*	20	10000	20	10000	20	10000	20	10000
Native Forb	*Calotis lappulacea*					0.1	10		
Native Sedge	*Carex inversa*			0.1	2				
Native Fern	*Cheilanthese sieberi*	0.1	1			0.1	10	0.1	2
Exotic Herb	*Chenopodium murale*								
Native Grass	*Chloris truncata*	0.25	50			2	50	1	50
Exotic Grass	*Cynodon incompletus*			2	1000				
Native Grass	*Dicanthium sericeum*		10000	5	10000	20	10000	5	1000
Native Grass	*Digitaria sp.*	1	50			1	100	0.1	1
Exotic Herb	*Dysphania pumilio*	0.5	50	0.1	2	0.5	50	1	50
Native Chenopod	*Einadia trygonos*			30	10000			2	200
Native Grass	*Enneapogon gracilis*	20	1000	5	1000			20	10000
Exotic Grass	*Eragostis curvula*			2	100	0.1	20		
Exotic Grass	*Eragrostis cilianensis*	5	1000	0.1	10			0.5	20
Native Grass	*Eragrostis brownii*								
Native Tree	*Eucalyptus albens*			20	9				
Exotic Herb	*Euphorbia maculata*	0.25	50			0.5	50		
Native Forb	*Geranium solanderi*								
Exotic Herb	*Glossocardia bidens*								
Native Forb	*Glycine tabacina*			0.1	10				

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Growth Form	Plant Species	Plot 1		Plot 2		Plot 3		Plot 4	
		Cov.	Ab.	Cov.	Ab.	Cov.	Ab.	Cov.	Ab.
Exotic Herb	*Gomphrena celisoides*								
Exotic Herb	*Heliotropium amplexicaule*	0.25	1						
Exotic Herb	*Hypochaeris radicata*					0.1	1		
Exotic Herb	*Lepidium africanum*			0.1	2				
Exotic Shrub	*Lycium ferocissimum*			1	2				
Native Chenopod	*Maireana microphylla*								
Exotic Herb	*Malva parviflora*			0.1	10				
Native Grass	*Microlaena stipoides*			0.1	50				
Native Forb	*Oxalis perrenans*								
Exotic Grass	*Panicum capillare*					0.1	1	2	50
Native Grass	*Panicum simile*							0.1	1
Exotic Herb	*Pelargonium sp.*			0.1	10				
Native Grass	*Poa sp.*			0.1	10				
Native Forb	*Polymeria longifolia*					0.1	5		
Native Forb	*Portulaca oleracea*	0.5	100	1	50	2	500	2	500
Exotic Herb	*Rumex brownii*	0.1	1						
Native Chenopod	*Salsola australis*					0.1	1	0.1	1
Exotic Tree	*Schinus molle*								
Exotic Herb	*Schkuria pinnata*							0.1	5
Native Chenopod	*Sclerolaena muricata*								
Native Forb	*Sida corrugata*					0.1	20		
Exotic Herb	*Sida rhombifolia*	5	100			1	100	5	1000
Exotic Grass	*Sporobolus sp.*	0.5	500						
Exotic Grass	*Tragus australis*							0.1	10
Native Forb	*Tribulus terrestris*	0.5	50	10	500	2	100	2	500
Exotic Herb	*Trifolium repens*	0.1	10						
Exotic Herb	*Trifolium sp.*								
Exotic Grass	*Urochloa panacoides*	0.1	5	5	50			2	100
Native Forb	*Vittadinia sp.*	0.1	20			1	200	0.5	20

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Growth Form	Plant Species	Plot 1		Plot 2		Plot 3		Plot 4	
		Cov.	Ab.	Cov.	Ab.	Cov.	Ab.	Cov.	Ab.
Native Forb	*Walenbergia communis*	0.5	100	1	50	1	100	1	500
Exotic Herb	*Xanthium spinosum*			0.1	1				

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.

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APPENDIX 3: THREATENED SPECIES 'LIKELIHOOD OF OCCURRENCE'

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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.	*Cadellia pentastylis* Ooline	V	V	-	PMST	Forms a closed or open canopy mixing with eucalypt and cypress pine species.There appears to be a strong correlation between the presence of Ooline and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sandy loam surface layer, grading from a light clay to a medium clay with depth. **A readily identifiable species that is detectible at all times of year. Was not detected within the subject site during the assessment. This site does not contain suitable habitat for this species.**	Nil	Nil
2.	*Callistemon pungens* -	-	V	-	PMST	In NSW the species occurs from near Inverell to the eastern escarpment in New England National Park. It also occurs in the northern tablelands of south-eastern Queensland, mainly in the Stanthorpe area. Habitats range from riparian areas dominated by Casuarina cunninghamiana subsp. cunninghamiana to woodland and rocky shrubland. It is often found in rocky watercourses, usually with sandy granite (occasionally basalt) creek beds. **A readily identifiable species that is detectible at all times of year. Was not detected within the subject site during the assessment. This site does not contain suitable habitat for this species.**	Nil	Nil

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
3.	*Dichanthium setosum* 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; however, potential habitat is present.**	Moderate	Low
4.	*Euphrasia arguta*	CE	CE	-	PMST	Historic records of the species noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers'. Plants from the Nundle area have been reported from eucalypt forest with a mixed grass and shrub understorey; here, plants were most dense in an open disturbed area and along the roadside, indicating the species had regenerated following disturbance. **Was not detected within the subject site during the assessment. This site does not contain suitable habitat for this species.**	Nil	Nil
5.	*Prasophyllum 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. **This species is not known in the Glenn Innes-Guyra Basalts Sub-region. This species was not detected within the subject site during the assessment.**	Low	Low

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
6.	*Syzygium paniculatum* Magenta Lilypily	E	V	1	Bionet	On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities. **The subject site is comprised of agricultural lands that contain few native trees. The habitat is considered unsuitable for this species.**	Nil	Nil
7.	*Thesium australe* 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 (*Themeda australis*). This species is a root parasite which takes water and some nutrient from other plants, especially Kangaroo Grass. **The majority of the subject site has been intensely grazed by livestock. 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.**	Low	Low
8.	*Tylophora linearis*	V	E	-	PMST	Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla* and *Allocasuarina luehmannii.* **The majority of the subject site has been intensely grazed by livestock. 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.**	Low	Low
Amphibians								

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
1.	*Litoria booroolongensis* Booroolong Frog, Yellow-spotted Bell Frog	E	E	-	PMST	Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins. Shelter under rocks or amongst vegetation near the ground on the stream edge. **No suitable aquatic habitat present within the subject site.**	Nil	Nil
Birds								
1.	*Anthochaera phrygia* Regent Honeyeater	CE	CE	-	PMST	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.	*Botaurus poiciloptilus* Australasian Bittern	E	E	-	PMST	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha spp*.) and spikerushes (*Eleocharis spp*.). **No suitable aquatic habitat is present within the subject site.**	Nil	Nil
3.	*Calidris ferruginea* 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

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
4.	*Erythrotriorchis radiatus* 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. **No suitable habitat is present within the subject site.**	Low	Low
5.	*Falco subniger* Black Falcon	V	-	2	Bionet PMST	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring. **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.	*Glossopsitta pusilla* Little Lorikeet	V	-	1	Bionet	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the 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

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
7.	*Grantiella picta* Painted Honeyeater	V	V		PMST	Inhabits Boree/ Weeping Myall (*Acacia pendula*), Brigalow (*A. harpophylla*) 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 Amyema. **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
8.	*Lathamus discolor* 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 *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Forest Red Gum *E. tereticornis*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens.* **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

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
9.	*Lophoictinia isura* Square-tailed Kite	V	-	1	Bionet PMST	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. **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
10.	*Rostratula australis* Australian Painted Snipe	E	E		PMST	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
Mammals								
1.	*Chalinolobus dwyeri* Large-eared Pied Bat	V	V		PMST	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. **No cave habitat is present within the subject site.**	Nil	Nil
2.	*Dasyurus maculatus (SE mainland population)* Spot-tailed Quoll	V	E	4	Bionet 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

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
3.	*Nyctophilus corbeni* Corben's Long-eared Bat	V	v		PMST	Inhabits a variety of vegetation types, including Mallee, Bulloke *Allocasuarina leuhmanni* 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.**	Low	Low
4.	*Petauroides volans* Greater Glider	-	v		PMST	Distribution levels are higher in regions of montane forest containing Manna Gum *(E. viminalis)* and mountain gum *(E. dalrympleana, E. obliqua).* Furthermore, the presence of *E. cypellocarpa* appears to improve the quality of habitat for the greater glider in forests dominated by *E. obliqua.* 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. **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
5.	*Petrogale penicillata* 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

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
6.	*Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)* Koala	V	V	1	Bionet PMST	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 (White Box *E. albens*) were 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
7.	*Pteropus poliocephalus* Grey-headed Flying-fox	V	V	12	Bionet PMST	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. **Potential foraging habitat occurs within canopy gums; however, no camps were detected. The habitat is not considered to be important to this species.**	Low	Low
Reptiles								
1.	*Aprasia parapulchella* Pink-tailed Worm Lizard	V	V	-	PMST	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. **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

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
2.	*Uvidicolus sphyrurus* 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
Migratory Species								
1.	*Apus pacificus* 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.	*Hirundapus caudacutus* White-throated Needletail	-	M		PMST	Forages in high open spaces over varied habitat types. **Potential aerial foraging habitat above study area.**	Moderate	Low
3.	*Motacilla flava* Yellow Wagtail	-	M		PMST	Typically inhabits inundated fields, saltmarsh and wetlands and occasionally coastal areas. **No suitable habitat within the study area.**	Nil	Low
4.	*Myiagra cyanoleuca* 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
5.	*Rhipidura rufifrons* 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

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APPENDIX 4: EPBC ACT PROTECTED MATTERS SEARCH REPORT

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Australian Government
Department of the Environment and Energy

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.

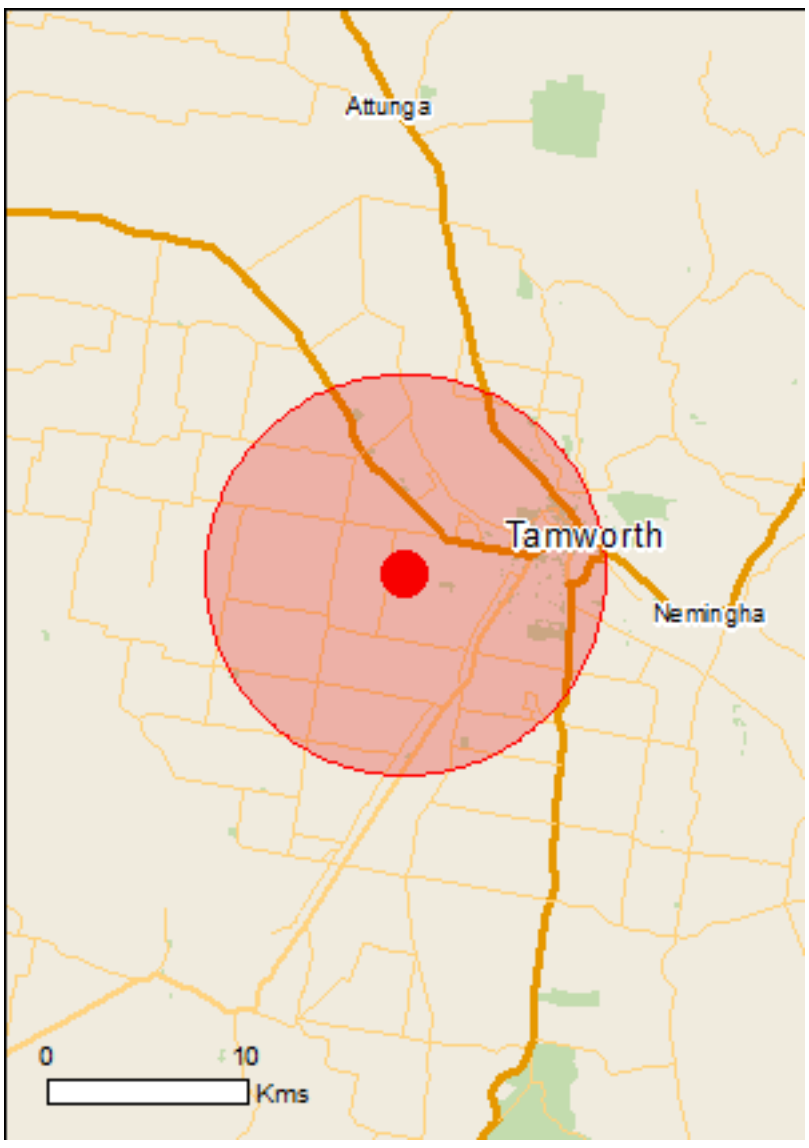
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 24/03/20 11:04:03

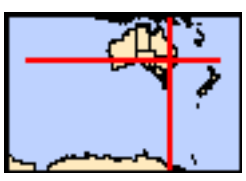
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

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:	4
Listed Threatened Species:	26
Listed Migratory Species:	11

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:	10
Commonwealth Heritage Places:	1
Listed Marine Species:	18
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:	33
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]

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
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
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]

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
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely 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
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence within area
Fish		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat known to 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 may 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 known 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	Roosting known to occur within area
Plants		
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area
Callistemon pungens [55581]	Vulnerable	Species or species habitat may 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
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

Name	Status	Type of Presence
		area
Uvidicolus sphyrurus Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat likely to 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 likely 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
Pandion haliaetus Osprey [952]		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 - Australian & Overseas Telecommunications Corporation
Commonwealth Land - Australian Postal Commission
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Commonwealth Bank of Australia
Commonwealth Land - Commonwealth Trading Bank of Australia
Commonwealth Land - Defence Housing Authority
Commonwealth Land - Defence Service Homes Corporation
Commonwealth Land - Director of Defence Service Homes
Commonwealth Land - Director of War Service Homes
Defence - TAMWORTH GRES DEPOT ; BEERSHEBA BARRACKS-TAMWORTH

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Tamworth Post Office	NSW	Listed place

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 likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur

Name	Threatened	Type of Presence 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
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may 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 likely to occur within area

Extra Information

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
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 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		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		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
Dolichandra unguis-cati Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw		Species or species

Name	Status	Type of Presence
Creeper, Funnel Creeper [85119]		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 within area
Senecio madagascariensis Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624]		Species or species habitat likely to occur within area
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		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

-31.10816 150.84972

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
-Australian Institute of Marine Science
-Reef Life Survey Australia
-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.

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

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

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Threatened Flora

Table 4: Bluegrass *Dicanthium setosum*

Factors	Assessment of Significance
(a) Effect on life cycle	Bluegrass *Dicanthium setosum* was not detected within the subject site during the assessment; however, records of the species occur in the locality and suitable habitat has been identified within the subject site. The proposed development will require ground disturbance that would result in the removal of some groundcover vegetation; however, most of the grasslands will be retained in their current state. Given that no areas of the subject site were found to contain Bluegrass and the majority of the habitat for the species 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	The majority of the habitat for the species will be retained within the subject site following the proposed development.
(c) (ii) Habitat Fragmentation	The groundcover habitat to be removed is comprised of non-native agricultural grassland. No areas of native grassland were identified; therefore, the proposed development will not cause further habitat fragmentation for the species within the locality.
(c) (iii) Habitat importance	The habitat to be removed is comprised of exotic/native grassland and is not considered important to the species. 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	The following KTPs are listed in order of their relevance to the EEC and the proposed development: • Removal of native vegetation • Loss of Hollow-bearing Trees • Removal of dead wood and dead trees • Invasion of native plant communities by exotic perennial grasses • Invasion of native plant communities by African Olive *Olea europaea* subsp. *cuspidata* (Wall. ex G. Don) Cif. • Infection of native plants by *Phytophthora cinnamomi*" 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 the above listed KTPs to a minor extent. Impacts are likely to be negligible.
Conclusion	As the proposed development will not impact an area containing a known occurrence of Bluegrass and the majority of 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.

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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.

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Biodiversity Development Assessment Report



KDC Pty Ltd

Tamworth Solar Project
Lot 211 DP 1069964

Country Road, Westdale NSW

25 January 2021

Biodiversity Development Assessment Report

Tamworth Solar Project

Lot 211 DP 1069964

Country Road, Westdale NSW

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BAM Calculator number: 00021881/BAAS18041/20/00021882

Prepared for:

KDC PTY LTD

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1. INTRODUCTION

1.1 SCOPE

Kleinfelder was engaged by KDC Pty Ltd on behalf of Providence Asset Group to prepare a Biodiversity Development Assessment Report (BDAR) for the proposed solar farm located within Lot 211 DP 1069964 at Country Road, Westdale NSW. This assessment has been undertaken in accordance with the Biodiversity Assessment Method 2020 (BAM) (Department of Planning, Industry and Environment [DPIE], 2020a). The BDAR will support an application under Part 4 of the *Environmental Planning & Assessment Act* 1979 (EP&A Act) for the Tamworth Solar Project .

The following terms are used throughout this report to describe geographical areas:

- Study Area: Lot 211 DP 1069964 at Country Road, Westdale NSW (**Figure 1**).
- Development Site: the area to be directly impacted due to the proposed development (**Figure 1**).
- Locality: land within a 5 km radius of the Study Area (**Figure 2**).

1.1 SITE DESCRIPTION

The Study Area is located approximately 1.5 km southwest of the township of Tamworth within the Tamworth Regional Council Local Government Area (LGA). The site is zoned 'RU4 – Primary Production Small Lots' under the *Tamworth Local Environmental Plan* (LEP) (Tamworth LEP, 2010). The predominant land use within the locality is agricultural development.

The western boundary of the Study Area is bordered by Country Road. The northern and eastern boundaries are bordered by an unnamed access road to rural dwellings and agricultural land to the south. A quarry is located in the south west of the Study Area. The topography is relatively flat with an elevation ranging from between 400 m to 435 m.

A first order stream is mapped within the Development Site, in a northeast direction toward Timbumburi Creek, which occurs approximately 1.2 km to the east. The stream is ephemeral,

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as water and riparian vegetation was absent during the assessment. A large constructed dam is located near the quarry. Four first order streams flow into the constructed dam and one second order stream flows from the dam toward Timbumburi Creek to the northeast.

The Study Area has previously been cleared of native vegetation for agricultural development (i.e. grazing) and to facilitate use of the quarry. Several cattle were observed throughout the Study Area during the assessment. Remaining native vegetation consists of areas of grassland, isolated mature trees and small areas of woodland regrowth.

1.2 PROPOSED DEVELOPMENT

The Tamworth Solar Farm Project will include a 5 MW grid-connected solar PV installation. The proposed project layout is provided in **Figure 1**.

Access to the solar farm will be achieved via Country Road. The access will lead into a car park area and an off-load area. The proposed laydown area (manoeuvring area) will be located midway along the southern boundary of the site via an internal access road from the site entrance. This area will also provide space for car parking and a prefabricated unit drop off area during the construction phase. The solar panels will be enclosed by a 1.8 m security fence with security gates for access.

1.3 INFORMATION SOURCES

The following information sources were utilised to inform the biodiversity development assessment which provided knowledge of existing literature pertaining to the Development Site and broader locality:

- The NSW DPIE BioNet Vegetation Classification (formerly known as the NSW Vegetation Information System Classification Database) (DPIE, 2020b).
- The NSW DPIE Threatened Biodiversity Data Collection (formerly known as the Threatened Species Profile Database) (DPIE, 2020c).
- The NSW DPIE BioNet Atlas of NSW (formerly known as the NSW Wildlife Atlas) (DPIE, 2020d).
- The Commonwealth Department of the Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) for Matters of National Environmental Significance (MNES) (DAWE, 2020a).

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- The Commonwealth DAWE *Species Profile and Threats Database* (SPRAT) (DAWE, 2020b).
- Relevant published literature.

1.4 LEGISLATIVE CONTEXT

An assessment of the proposed development was undertaken in accordance with and in consideration of the following Acts and Policies:

- Commonwealth:
  - *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- State:
  - Biodiversity Assessment Method (DPIE, 2020a)
  - *Biodiversity Conservation Act 2016* (NSW) (BC Act)
  - *Biodiversity Conservation Regulation 2017* (NSW) (BC Regulation)
  - *Environmental Planning and Assessment Act 1979* (EP&A Act)
  - *Biodiversity Conservation (Savings and Transitional) Regulation 2017*
  - *Biosecurity Act 2015*
  - *Local Land Services Act 2013* (LLS Act)
  - *State Environmental Planning Policy (Koala Habitat Protection) 2019* (Koala SEPP)
  - Draft *State Environmental Planning Policy (Environment)*
- Local:
  - *Tamworth Local Environmental Plan 2010*
  - *Tamworth Regional Development Control Plan 2010*

1.4.1 Environment Protection & Biodiversity Conservation Act 1999

Under the EPBC Act assessment, an approval is required for actions that are likely to have a significant impact on matters of national environmental significance (MNES). An action includes a project, development, undertaking, activity, or series of activities. When a person proposes to take an action, they believe may need approval under the EPBC Act, they must refer the proposed development to the Australian Government Minister for the Environment. The Act identifies nine MNES:

1. World Heritage properties.
2. National heritage places.
3. Wetlands of international importance (Ramsar Convention).

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4. Listed threatened species and communities.
5. Migratory species listed under international agreements.
6. Great Barrier Reef Marine Park.
7. Commonwealth marine areas.
8. Nuclear actions.
9. Water resources in respect to Coal Seam Gas and large coal mines.

While this BDAR is not required to address MNES, the proponent is required to address the EPBC Act as part of their development application. Items 4 and 5 are relevant to the current proposed development.

1.4.2 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 Tamworth Regional Council.

1.4.3 Biodiversity Conservation Act 2016 (NSW)

As per Part 7.7 of the BC Act, all applications for development consent under Part 4 of the EP&A Act are to be accompanied by a BDAR[1] unless the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values. Part 7.2 of the BC Act states that a development is likely to significantly affect threatened species if it:

- Is carried out within an area of Outstanding Biodiversity Value, or
- Exceeds the Biodiversity Offset Scheme (BOS) thresholds, which includes:
  - Clearing of native vegetation, or undertaking a prescribed activity, on land mapped on the NSW Biodiversity Vales Map (BV Map), or
  - Clearing of native vegetation of an area declared by clause 7.2 of the BC Regulation as exceeding the threshold.

[1] With the exception of:
(a) an application for development consent for State significant development, or
(b) an application for a complying development certificate.

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- Is likely to significantly affect threatened species or ecological communities, or their habitat, according to the test in section 7.3 (5-part test).

The proposed development does not occur within an area of Outstanding Biodiversity Value (AOBV). The NSW biodiversity values map was reviewed, and there are no areas of biodiversity value mapped within the Study Area.

Under clause 7.2 of the BC Regulation, the area of native vegetation clearing threshold for the proposed development is 1 ha or more, as the minimum lot size of the Development Site is 40 ha. The proposed development will directly impact on approximately 11.31 ha of native vegetation. As such, the proposed development exceeds the native vegetation clearing threshold set out in the BC Regulation, and a BDAR is required for the proposed development.

The Biodiversity Accredited Assessor System (BAAS) Case number for the project is 00021881. Dr. Gilbert Whyte is the BAM Accredited Assessor who undertook the fieldwork and reporting for the project (Assessor No. BAAS18041). The BAM Calculator number for the project is 00021881/BAAS18041/20/00021882.

1.4.4 Biosecurity Act 2015

Under the *Biosecurity Act 2015* 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.*" Under the Act, a biosecurity impact "*is an adverse effect on the economy, environment, or the community that arises, or has the potential to arise, from a biosecurity matter."*

A discussion of the incidence of weeds within the site is presented in **Section 7.2**. Mitigation measures to prevent the spread of weeds within the site are presented in **Section 5.3**.

1.4.5 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

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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 Study Area.

1.4.6 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.

One stream is mapped as occurring within the Development Site (**Figure 1**). The stream is ephemeral, as water and riparian vegetation was absent during the assessment. Notwithstanding, the application of the WM Act, an assessment of indirect impacts of the proposed development on aquatic habitat and downstream aquatic habitats is provided in **Section 6**.

1.4.7 State Environmental Planning Policy (Koala Habitat Protection) 2020

State Environmental Planning Policy (SEPP) *(Koala Habitat Protection) 2020* commenced on 30 November 2020 to replace and repeal the *State Environmental Planning Policy (Koala Habitat protection) 2019* (2019 Koala SEPP). The Koala SEPP 2020 replicates the objectives and provisions of SEPP 44, which was in force from 1995 through to 2019.

The SEPP:

- Provides a framework for councils to prepare a strategic koala plan of management that would apply to the whole or part of a LGA.
- Applies to development applications on land over one hectare in a relevant LGA.
- Requires development applications to be consistent with a council strategic koala plan of management that applies to the land, or, if there is no strategic plan, sets out a two-step

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process to determine if the land is core koala habitat and if it is, produce an Individual Koala Plan of Management before council can grant consent to a development application.

- Exempts clearing of vegetation from the application of the SEPP if the purpose of the clearing is to maintain an Asset Protection Zone as part of rebuilding a dwelling destroyed or damaged by bushfire and allows the dwelling to be sited anywhere on the lot.
- Saves all Koala Plans of Management approved under SEPP 44 and 2019 Koala SEPP.

The Koala Habitat Protection SEPP is applicable to the proposed development due to the following:

- Tamworth Regional Council LGA is listed under Schedule 1 of the SEPP (Koala Habitat Protection) 2020.
- The proposed development will require the removal of White Box *Eucalyptus albens,* which is listed as a preferred Koala feed tree under Schedule 2 of the SEPP (Koala Habitat Protection) 2020.
- The Development Site is greater than 1 ha.

See **Section 4.1.7** for a summary of the Koala habitat assessment.

1.5 LOCAL PLANNING INSTRUMENTS

1.5.1 Tamworth Local Environmental Plan 2010

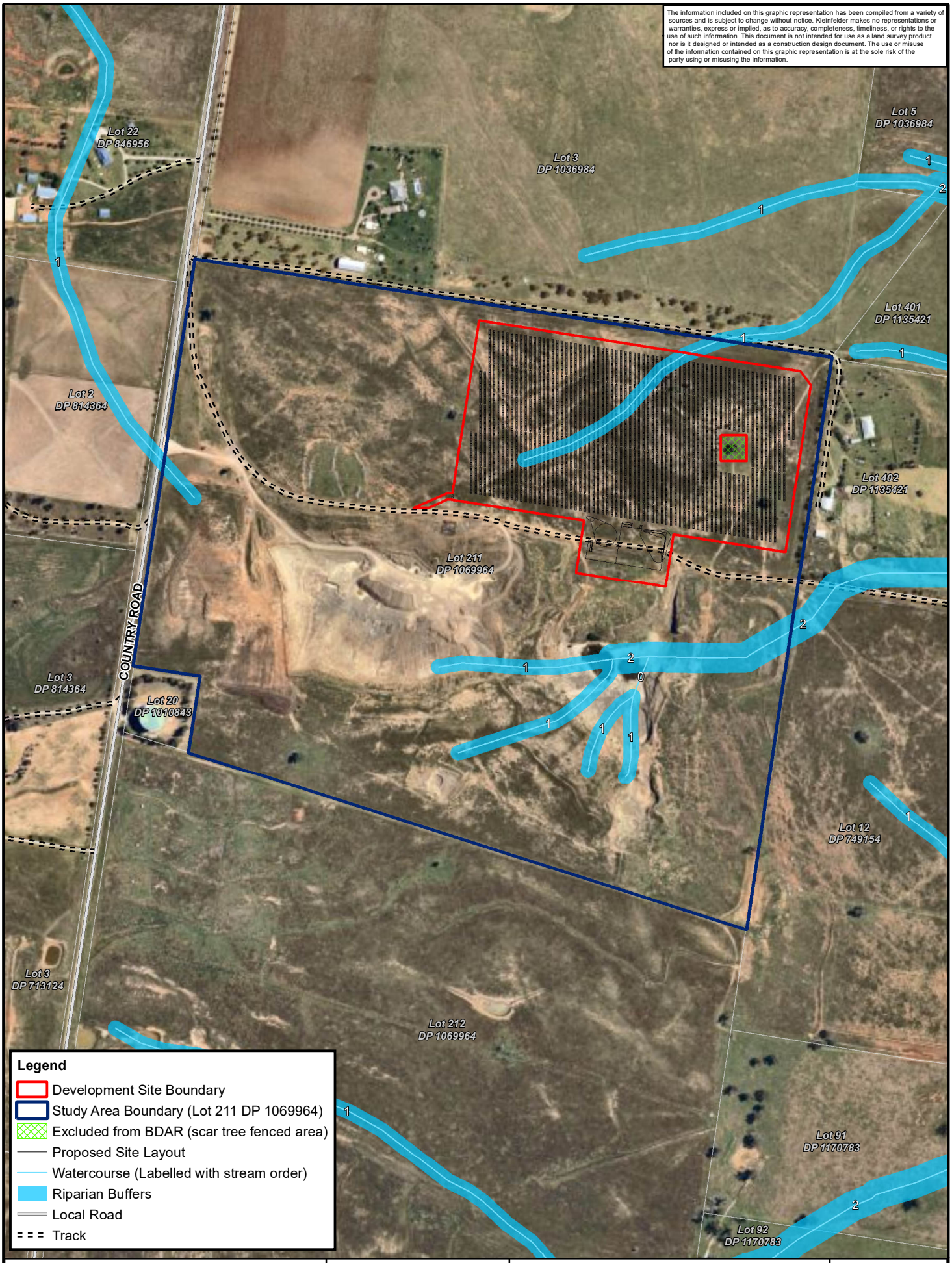
The Study Area is located within the Tamworth Regional Council LGA. The Tamworth LEP (Tamworth LEP, 2010) controls development within the Study Area through zoning and development controls. These controls are described in greater detail by the supporting *Tamworth Development Control Plan* (DCP) (Tamworth DCP, 2010).

1.5.2 Tamworth Regional Development Control Plan 2010

The Tamworth DCP supports the Tamworth LEP by providing additional detail and guidance on addressing biodiversity issues associated with development. In regard to biodiversity, the DCP contains provisions that relate to environmental effects, soil and erosion control and vegetation. These provisions have been considered during the assessment.

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Legend

- Development Site Boundary
- Study Area Boundary (Lot 211 DP 1069964)
- Excluded from BDAR (scar tree fenced area)
- Proposed Site Layout
- Watercourse (Labelled with stream order)
- Riparian Buffers
- Local Road
- Track

Metres
0 25 50 100 150 200 250

N

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PROJECT REFERENCE: 20203963

DATE DRAWN: 2021/01/21 16:22 Version 2

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2018
NSW OEH - 2019
Nearmap - 2020

Development Site

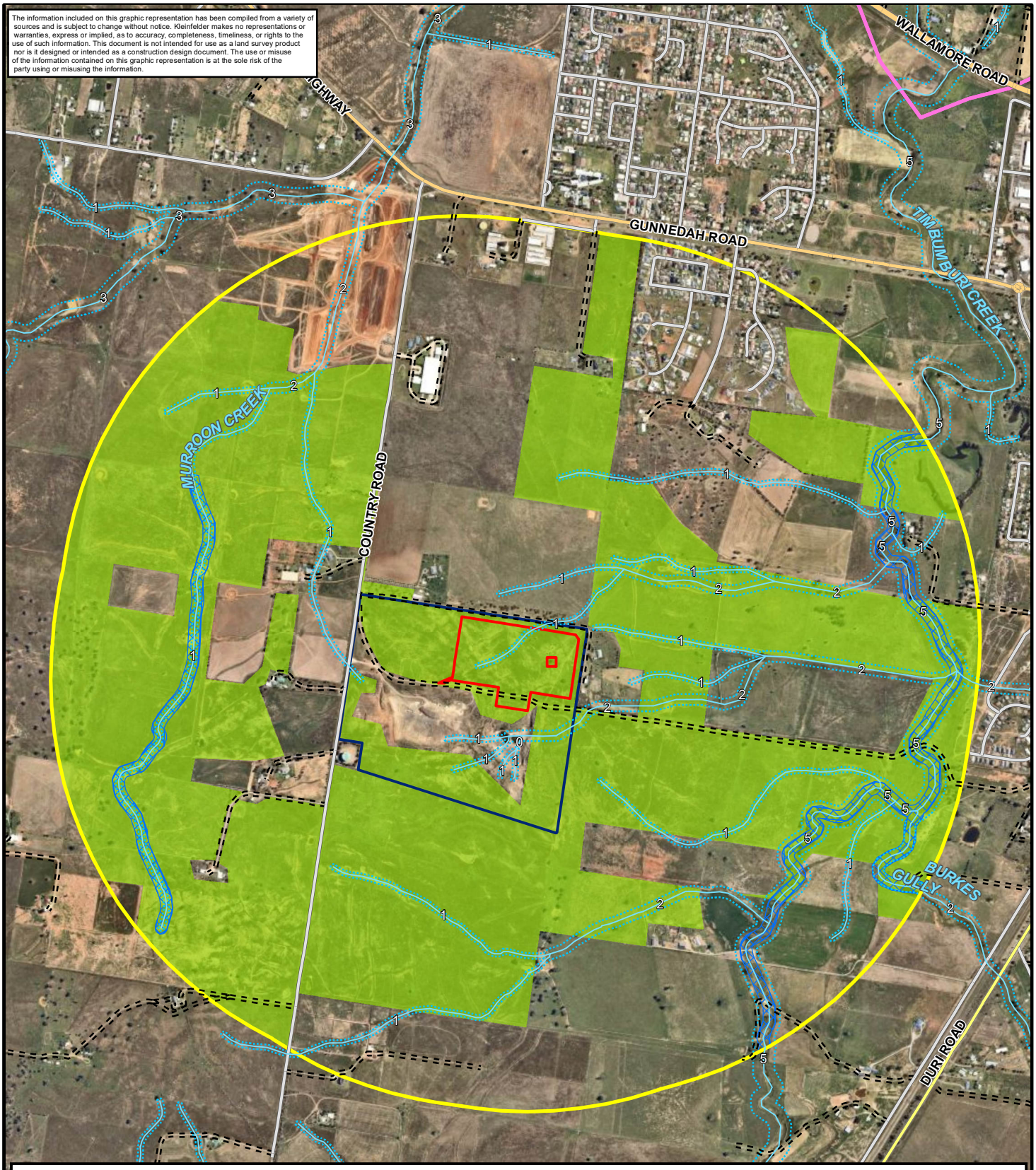
KDC Pty Ltd
Biodiversity Development Assessment Report
South Tamworth Solar Farm

FIGURE:

1

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Legend

- Development Site Boundary
- Study Area Boundary (Lot 211 DP 1069964)
- IBRA Sub-region Boundary (V7) - Map extent is entirely Nandawer Region/Peel Sub-region
- Landscape Assessment - 1500m Buffer
- Landscape Assessment - Native Vegetation

Biodiversity Values (v9)

- Protected Riparian Land
- Watercourse (Labelled with stream order)
- Riparian Buffers
- Primary Road
- Arterial Road
- Sub-arterial Road
- Local Road
- Track

Metres
0 100 200 400 600 800 1,000
N

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PROJECT REFERENCE: 20203963
DATE DRAWN: 2021/01/21 15:54 Version 2
DRAWN BY: GJoyce
DATA SOURCE:
NSW DFSI - 2018
NSW OEH - 2020
Nearmap - 2020

Development Site Location

KDC Pty Ltd
Biodiversity Development Assessment Report
South Tamworth Solar Farm

FIGURE:
2

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2. LANDSCAPE CONTEXT

2.1 LANDSCAPE FEATURES

The landscape features and site context detailed in Section 4 of the BAM (DPIE, 2020a) are described in **Table 1**. These landscape features are also shown in **Figure 2**.

Table 1: Landscape Features of the Development Site

Landscape Feature	Development Site
IBRA bioregion	NSW Nandewar Interim Biogeographic Regionalisation for Australia (IBRA) bioregion.
IBRA subregion	Peel IBRA sub-region.
LGA	Tamworth Local Government Area.
Mitchell Landscapes	Tamworth – Keepit Slopes and Plains This landscape occurs on undulating to rolling slopes and plains with low hills and low ranges forming the western fall of the New England plateau. Complex geology of folded and faulted sedimentary and metamorphic rocks with minor interbedded volcanics. Rock types include, Silurian-Devonian chert, slate, phyllite, tuff, schist and Carboniferous conglomerate, sandstone, mudstone, andesite and small areas of limestone. General elevation is from 500 to 800 meters (Mitchell, 2002).
Rivers, streams and estuaries	An ephemeral first order stream is mapped through the Development Site. A large constructed dam occurs within the quarry area to the south. Four first order stream flow into this dam and one second order stream flows from the dam toward Timbumburi Creek to the northeast.
Wetlands	There are no mapped Important Wetlands (SEPP Coastal Wetland) or Ramsar listed wetlands in the Study Area or Development Site, or 1,500 m buffer.
Connectivity of different areas of habitat	The Development Site has previously been cleared of native vegetation for agricultural development (i.e. grazing) and for the quarry. Remaining native vegetation consists of areas of native/exotic grassland and isolated mature trees. The surrounding landscape is also comprised predominantly of agricultural development.
Areas of geological significance and soil hazard features	There are no areas of geological significance within the Development Site. The Development Site is not mapped on Class 5 soils. The site is therefore considered to have a low risk of soil hazard features.
Areas of outstanding biodiversity value	There are no areas of outstanding biodiversity value mapped within the Development Site.

2.2 SITE CONTEXT

Details of the landscape assessment for the Development Site, according to the BAM (DPIE, 2020a) using the site-based assessment methodology and determined by remote sensing and GIS are detailed below.

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2.2.1 Native Vegetation Cover

Native vegetation cover estimated to remain in the landscape proximal to the Development Site has been calculated within a 1,500 m site buffer. The 1,500 m site buffer area has an area of 928 ha, with an estimated native vegetation cover (i.e. native grasslands) cover of 500 ha or 54% (**Figure 2**).

2.2.2 Geology and Soils

The Tamworth – Keepit Slopes and Plains landscape is described by Mitchell (2002) as having a “Complex geology of folded and faulted sedimentary and metamorphic rocks with minor interbedded volcanics. Rock types include, Silurian-Devonian chert, slate, phyllite, tuff, schist and Carboniferous conglomerate, sandstone, mudstone, andesite and small areas of limestone. Shallow stony soils on ridges. Texture contrast soils on almost all slopes shifting in colour from red-brown on upper slopes to yellow with harsh subsoils prone to gully development on lower slopes.”

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3. NATIVE VEGETATION

3.1 METHODOLOGY

Native vegetation at the Development Site was assessed in accordance with Section 5 of the BAM (DPIE, 2020a).

3.1.1 Data Review

Vegetation mapping completed as part of the State Vegetation Type Map: *Border Rivers Gwydir / Namoi Region (Version 2.0. VIS_ID 4467)* was reviewed to assist with the determination of Plant Community Types (PCTs) within the Study Area.

3.1.2 Vegetation Mapping Surveys

Vegetation Mapping and Surveys

Detailed vegetation surveys were conducted across the Study Area on 04 March 2020 and 04 January 2021. Areas of vegetation to be impacted by the amended development design were mapped during this period.

The boundaries of each of the identified vegetation communities within the Study Area were mapped using a combination of rapid data points (RDP) and walking transects, using the polygons produced through aerial photo interpretation (API) to assist in targeting survey effort. RDPs involved collecting waypoints over the Study Area using a handheld Trimble™ GPS unit and recording dominant species, structure and condition. Walking transects involved verifying polygons were homogenous in floristic composition and condition, as well as walking vegetation ecotones and using the recorded tracks to define vegetation community boundaries. The RDPs and survey tracks were then overlaid on an aerial photograph and used to delineate and/or clarify vegetation boundaries.

Linework and Attribution

RDPs and plots were classified and tagged with a PCT by field surveyors. Polygons produced from the API work adopted the PCT of the sample point that they intersected.

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Plant Community Type Determination

Each vegetation community identified within the Study Area was assigned to the closest equivalent PCT from those listed in the BioNet Vegetation Classification database (DPIE, 2020b). The closest equivalent PCT for each vegetation community was determined through a comparison of the floristic descriptions of PCTs in the database with the plot / transect data collected from the site. In addition to floristic and structural similarity, the landscape position, soil type and other diagnostic features of the vegetation communities on the site were compared to the descriptions in the database to determine the most suitable PCT. Threatened ecological communities (TECs) as defined in NSW and Commonwealth legislation were also identified if present.

Vegetation Zones

Vegetation zones were identified and delineated on the Development Site in accordance with Section 4.3 of the BAM (DPIE, 2020a). A vegetation zone is defined in the BAM as a relatively homogenous area that is the same vegetation type and broad condition.

Assessing Vegetation Integrity (Site Condition)

Following stratification of the Development Site into vegetation zones, plots/transects were undertaken to collect site condition data for the composition, structure and function attributes listed in **Table 2** in accordance with Section 4.3 of the BAM (DPIE, 2020a). The location of the plots/transects were selected through stratified random sampling to provide a representative sample of the variation in vegetation composition and condition within each vegetation zone.

Table 2: Composition, Structure and Function components of vegetation integrity

Growth form groups used to assess composition (species richness) and structure (percent foliage cover)	Function attributes
• Tree (TG) • Shrub (SG) • Grass and grass-like (GG) • Forb (FG) • Fern (EG) • Other (OG)	• Number of large trees • Tree regeneration (presence/absence) • Tree stem size class (presence/absence) • Total length of fallen logs • Litter cover • High threat exotic vegetation cover (HTE) • Hollow-bearing trees (HBT)

The number of plots/transects undertaken across the site meets the minimum number of transects required for each vegetation zone area as detailed in Section 4.3.4, Table 3 of the BAM (DPIE, 2020a). Four plots were undertaken within the Study Area. The locations of the

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plots / transects undertaken on the Development Site are shown on **Figure 3.** Floristic Identification and Nomenclature

Floristic identification and nomenclature was based on Harden (1992, 1993, 2000 and 2002) with subsequent revisions as published on PlantNet (http://plantnet.rbgsyd.nsw.gov.au).

3.2 ASSESSMENT RESULTS

3.2.1 Vegetation within the Development Site

3.2.1.1 Weeds

No major infestations of priority weeds (DPI, 2020) or Weeds of National Significance (WoNS) (DoEE, 2020c) were identified. Minor infestations of weeds were identified, including the following species:

- African Love Grass *Eragrostis curvula.*
- African Box Thorn *Lycium ferocissimum.*
- Bathurst Burr *Xanthium spinosum.*

Mitigation measures to prevent the spread of weeds are presented in **Section 5.3.**

3.2.1.2 Vegetation Description

One PCT was identified within the Development Site (**Table 3**); *PCT 511 - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion*.

Table 3: Plant Community Types within the Development Site

PCT	Vegetation Formation	Vegetation Class	Area (ha)
PCT 511 - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands	11.31
Total			**11.31**

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3.2.1.3 Vegetation Zones

The vegetation identified within the Development Site was considered to be in low condition across the entirety of the Study Area. Two vegetation zones were allocated:

- Zone 1 – PCT 511 Low Condition Grassland.
- Zone 2 – PCT 511 Low Condition Woodland.

Details on the vegetation zone (including condition class, area, patch size, survey effort and vegetation integrity score) are outlined in **Table 4**, and a full descriptions of the vegetation zone is provided in the following sub-sections **Figure 3** shows the distribution of vegetation zone within the Development Site. Plot data is provided in **Appendix 1**.

3.2.1.4 Assessment of Patch Size

The patch size for Vegetation Zone 1 was assessed as >100 ha as this zone is a grassland zone which is connected to large intact areas of grassland extending to the east, south and west. Vegetation Zone 2 is comprised of three small areas of woodland. Given that all three areas are separated by a gap <100m, the patch size for Vegetation Zone 2 is the total area (0.32 ha).

3.2.1.5 Vegetation Integrity Score

The current vegetation integrity score of the vegetation zones is outlined in **Table 4**.

Table 4: Current vegetation integrity score for the vegetation zone

Zone	PCT	Condition class	Area (ha)	Condition scores (Current Score)			Vegetation integrity score
				Composition	Structure	Function	
1	511	Low (Grasslands)	11.05	37.3	69	0.3	9.2
2	511	Low (Woodlands)	0.26	38.5	36.5	24.1	32.4

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Vegetation Zone 1



Plate 1: **PCT 511 - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Low Condition Grassland)**

PCT 511 - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Low Condition Grassland)	
Vegetation Formation and Class	Grassy Woodlands Western Slopes Grassy Woodlands
Area within Development Site	11.05 ha
Survey Effort	**Required:** 3 plot/transect.
	Conducted: 3 plot/transect (Q01, Q03 and Q04)
Floristic description	The dominant grass species throughout the vegetation zone is Great Brome *Bromus diandrus*. This introduced grass species had a projected ground cover of approximately 20% throughout the project site (**Plate 1**). Other dominant exotic plant species included the following: • Fishweed *Einadia trigonos* • Liverseed Grass *Urochloa panicoides* • Stinkgrass *Eragrostis cilianensis* • Fat Hen *Chenopodium album* • Crowsfoot Grass *Eleusine indica* Native grass species that occurred sparsely within the vegetation zone comprised the following species: • Purple Wiregrass *Aristida ramosa*

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PCT 511 - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Low Condition Grassland)	
	• Queensland Bluegrass *Dicanthium sericeum* • Pitted Bluegrass *Bothriochloa decipiens* • Red Grass *Bothriochloa macra* • Slender Nineawn *Enneapogon gracilis* • Purple Wiregrass *Aristida ramosa* • Windmill Grass *Chloris truncata* Native herb species that occurred sparsely throughout the vegetation zone, comprised the following: • Tarvine *Boerhavia dominii* • Yellow Buttons *Calotis lappulacea* • Native Geranium *Geranium solanderi* • *Glycine tabacina* • *Oxalis perrenans* • *Polymeria longifolia* • Pig Weed *Portulaca oleracea* • Corrugated Sida *Sida corrugata* • Caltrop *Tribulus terrestris* • Fuzzweed *Vittadinia cuneata*
Condition within Development Site	This vegetation zone has no intact native canopy or shrub layer. The groundcover was largely comprised of exotic grass species with occasional native species. The vegetation zone is in a low condition state.
Justification for PCT selection	The vegetation within the Study Area most closely resembles a degraded form of derived grassland associated with a Western Slopes Grassy Woodland due. Key diagnostic species that are typically associated with PCT 511 include the following: • Purple Wiregrass *Aristida ramosa* • Queensland Bluegrass *Dicanthium sericeum* • Red Grass *Bothriochloa macra* • Slender Nineawn *Enneapogon gracilis* • Windmill Grass *Chloris truncata* • Native Geranium *Geranium solanderi* • *Glycine tabacina* • *Oxalis perrenans*
Status	**BC Act:** The grasslands within the Development Site are dominated by exotic grasses and are considered to be too degraded to represent derived native grasslands of White Box Yellow Box Blakely's Redgum Woodland. Due to the low diversity of native grasses and herbs present, it is unlikely that the grasslands would respond to assisted natural regeneration. The Development Site does not adjoin any areas of better-quality habitat that would allow natural colonisation of native grasses and herbs. Many of the exotic grasses and herbs present are aggressive weeds that are difficult to eradicate without the use of herbicides.
	EPBC Act: Not Listed (see above)
SAII	No
PCT % Cleared	0% according to the BioNet Vegetation Classification

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Vegetation Zone 2



Plate 2: **PCT 511 - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Low Condition Woodland)**

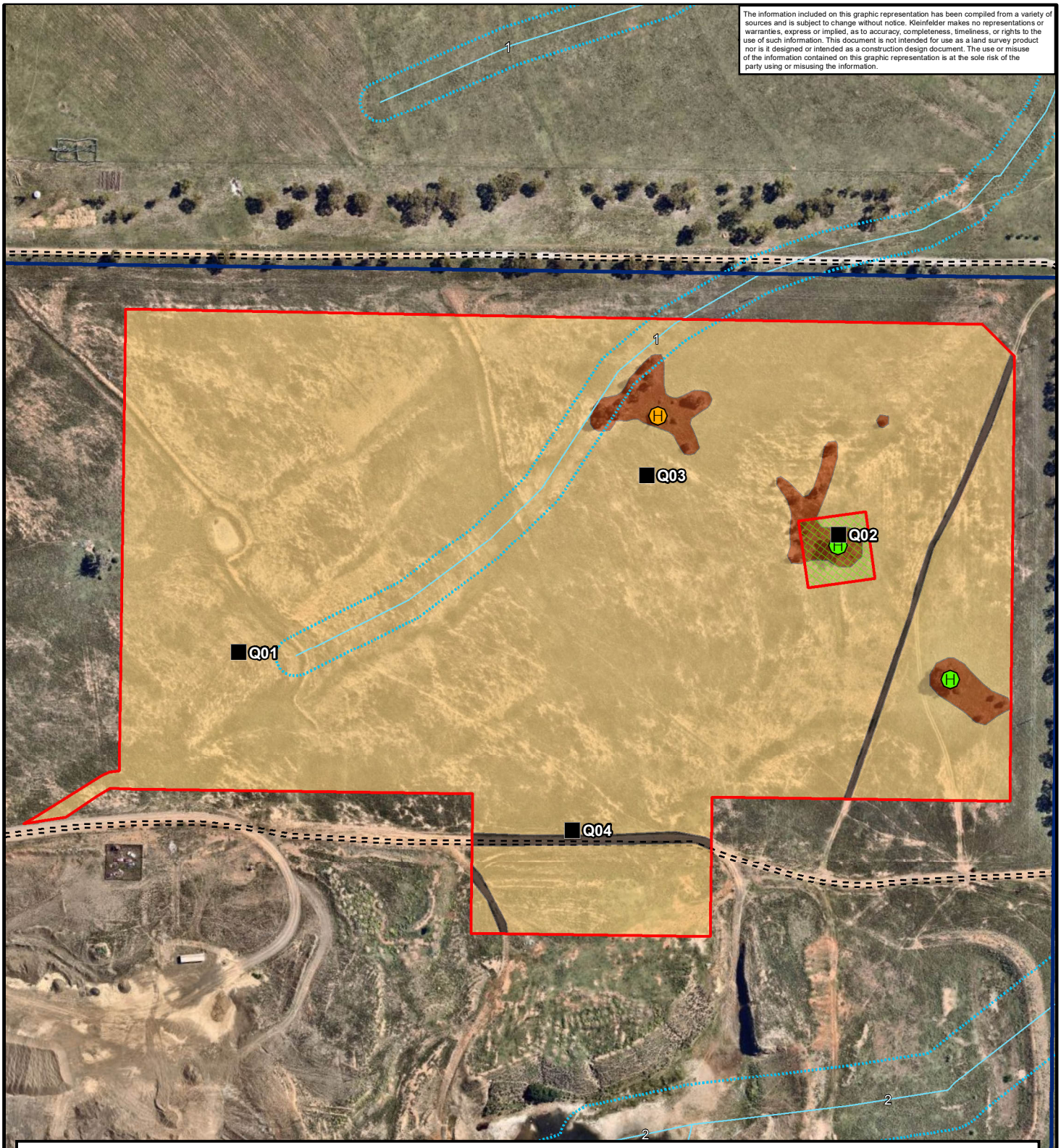
PCT 511 - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Low Condition Woodland)	
Vegetation Formation and Class	Grassy Woodlands Western Slopes Grassy Woodlands
Area within Development Site	0.26 ha
Survey Effort	**Required:** 1 plot/transect.
	Conducted: 1 plot/transect (Q02)
Floristic description	The vegetation zone is characterised by isolated mature White Box *Eucalyptus albens.* The shrub layer is largely absent; however, some regeneration was observed directly beneath the large trees. Thickets of introduced African Box Thorn *Lycium ferocissimum* also occur around the base of large trees (**Plate 2**). The dominant groundcover species within the vegetation zone comprised the following species: • Fishweed *Einadia trigonos* • Caltrop *Tribulus terrestris* • Slender Bamboo Grass *Austrostipa verticillata* • Bluegrass *Dicanthium sericeum* The dominant exotic groundcover species were: • Great Brome *Bromus diandrus*

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PCT 511 - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Low Condition Woodland)	
	• Liverseed Grass *Urochloa panicoides* • *Cynodon incompletus*
Condition within Development Site	This vegetation zone contains few isolated trees lacking an intact native shrub layer. The groundcover was largely comprised of exotic grass species with occasional native species. The condition of the vegetation zone is considered to be low.
Justification for PCT selection	The vegetation within the Study Area most closely resembles a degraded form of a Western Slopes Grassy Woodland. Key diagnostic species that are typically associated with the PCT 511 include canopy species such as White *Box Eucalyptus albens* and the following groundcover species: • Purple Wiregrass *Aristida ramosa* • Queensland Bluegrass *Dicanthium sericeum* • Red Grass *Bothriochloa macra* • Slender Nineawn *Enneapogon gracilis* • Windmill Grass *Chloris truncata* • Native Geranium *Geranium solanderi* • *Glycine tabacina* • *Oxalis perrenans*
Status	**BC Act:** The presence of White Box *Eucalyptus albens* within the Development Site indicates that prior to being cleared and grazed, the area was likely to contain White Box Yellow Box Blakely's Redgum Woodland, which is listed as an 'Endangered Ecological Community (EEC)' under the BC Act. In accordance with the Scientific Determination for the EEC (NSW Scientific Committee, 2011) "*Disturbed remnants are still considered to form part of the community including remnants where the vegetation, either understorey, overstorey or both, would, under appropriate management, respond to assisted natural regeneration, such as where the natural soil and associated seed bank are still at least partially intact*".
	EPBC Act: White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.
SAII	No
PCT % Cleared	0% according to the BioNet Vegetation Classification

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Legend

- Development Site Boundary
- Study Area Boundary (Lot 211 DP 1069964)
- Excluded from BDAR (scar tree fenced area)
- Hollow-bearing Tree
- Dead Stag
- Watercourse (Labelled with stream order)
- Riparian Buffers
- Track
- Plot Transect

Plant Community Types and Vegetation Zones

- PCT 511 - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Low Condition Grasslands) - **Zone 1**
- PCT 511 - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Low Condition Woodlands) - **Zone 2**
- Tracks

Metres
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PROJECT REFERENCE: 20203963

DATE DRAWN: 2021/01/21 16:19 Version 2

DRAWN BY: GJoyce

DATA SOURCE:
NSW DFSI - 2018
NSW OEH - 2019
Nearmap - 2020

Vegetation Zones, Plot Locations and Habitat Features

KDC Pty Ltd
Biodiversity Development Assessment Report
South Tamworth Solar Farm

FIGURE:

3

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4. THREATENED SPECIES

4.1 ASSESSING HABITAT SUITABILITY

The occurrence of threatened species and habitat suitability within the Development Site was assessed in accordance with Section 6 of the BAM (DPIE, 2020a).

4.1.1 Database Searches

To inform the assessment of suitable habitat for threatened species and populations within the Study Area, a database search of the NSW Department of Planning, Industry and Environment (DPIE) BioNet Atlas and the Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) were conducted. Results are provided in **Appendix 2**

4.1.2 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.

At the time of the assessment, the grasslands were tall and dense due to recent rainfall (i.e. greater than average summer rainfall). Leaf-litter and woody debris was generally absent having been pushed into windrows near the site entrance. The Development 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. In summary, the fauna habitat assessment determined the following:

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- The isolated mature trees within the Development Site may provide marginal foraging and nesting habitat for several common native bird species.
- The 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 may provide refuge habitat for fauna groups such as amphibians, reptiles and small mammals.
- The grasslands may provide hunting habitat for native predatory birds, such as Falcons, Kestrels and Large Forest Owls.
- Three hollow-bearing trees were identified within the Development Site. These hollows were inspected from the ground and were identified as being suitable nesting habitat for smaller birds such as parrots or roosting habitat for microchiropteran bats.

The Development Site is considered to have low habitat value for the majority of threatened fauna species known to occur within the locality. This determination is based on the following:

- The site is located within an agricultural landscape that has been subjected to widespread vegetation clearing for agricultural development (i.e. grazing and cropping). No adjacent areas of good quality fauna habitat such as woodland or forest occur.
- The native vegetation on site lacks an established canopy or shrub layer.
- Leaf litter and woody debris is generally absent throughout the site. This material has been removed (i.e. agricultural land management practise).
- Canopy tree species present within the Development Site are limited to few isolated White Box *Eucalyptus albens.* These trees would provide limited foraging habitat for fauna species such as woodland birds.

4.1.3 Habitat Tree Survey

A survey to identify hollow-bearing trees, dead standing stags and trees containing nests was undertaken. These surveys specifically targeted large hollows (>20 cm) which would indicate the presence of potential Large Forest Owl breeding habitat, and any trees containing large stick nests. Small (<5 cm) to medium (5-20 cm) sized hollows were also recorded if observed during the habitat tree survey. The location of habitat trees and the type of feature it contained was recorded using a handheld GPS.

Three hollow-bearing trees were identified within the Development Site (**Figure 3**). These hollows were inspected from the ground and were identified as being suitable nesting habitat for smaller birds such as parrots or roosting habitat for microchiropteran bats. All hollows were less than 15 cm in diameter and are therefore considered unsuitable for larger birds such as

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the Glossy Black Cockatoo or Large Forest Owls. Two hollow-bearing trees will require removal for the proposed development.

4.1.4 Opportunistic Observations

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.

4.1.5 Microbat Surveys

Microbat surveys were conducted using high frequency call recorders called 'Anabats', which capture call signatures specific to each microbat species. An Anabat Express detector (Titley Scientific) was deployed for one night in the central portion of the Development Site.

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.

4.1.6 Threatened Flora

Targeted searches for threatened species were conducted for the more resilient threatened flora species that are known to often persist in disturbed environments such as agricultural sites. The habitat is considered to be too degraded to support populations of the majority of threatened flora species known to occur within the locality. Long-term grazing within the site has reduced overall native plant diversity and facilitated the encroachment of exotic plant species.

4.1.7 Koala Habitat

Most of the Development Site has been cleared for agricultural development. Isolated mature trees were found to be comprised of White Box *Eucalyptus albens*, which is listed as a preferred Koala food tree species under Schedule 2 of the SEPP for Koala Habitat Protection (2020).

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An assessment of Koala habitat within the Development 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 Development Site are isolated in the landscape and are therefore unlikely to provide a resource substantial enough to support a Koala population.
- Only one historical record of a Koala occurs within 5 km of the Study Area (BioNet).

4.1.8 Ecosystem Credit Species

The following assessment of habitat suitability for ecosystem credit species was conducted in accordance with Section 6.2 of the BAM. Ecosystem credits represent threatened species that can be predicted to be present by the type and condition of vegetation at the Development Site. Targeted survey is not required for ecosystem credit species.

Step 1: Identify threatened species for assessment

A list of predicted ecosystem credit species for the Development Site was reviewed in the BAM calculator, according to PCTs present on the subject land.

Step 2: Assessment of the habitat constraints and vagrant species on the subject land

The potential for identified ecosystem credit species to occur on the Development Site was assessed according to species specific habitat requirements, as detailed in **Table 5**.

Where woodland habitat features were not present due to the degraded condition of the site vegetation, ecosystem credit species were determined to not be predicted species and no further assessment was required within these vegetation zones.

Table 5: Assessment of ecosystem credit species within the Development Site

Scientific name	Common name	Confirmed Predicted Species	Justification
Artamus cyanopterus cyanopterus	Dusky Woodswallow	Yes	-
Calyptorhynchus lathami (Foraging)	Glossy Black-Cockatoo	**No**	**Habitat constraints not present:** Lack of *Allocasuarina* and *Casuarina* species.
Chalinolobus picatus	Little Pied Bat	Yes	-
Chthonicola sagittata	Speckled Warbler	Yes	-
Circus assimilis	Spotted Harrier	Yes	-

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Scientific name	Common name	Confirmed Predicted Species	Justification
Climacteris picumnus victoriae	Brown Treecreeper (Eastern Subspecies)	Yes	-
Daphoenositta chrysoptera	Varied Sittella	Yes	-
Dasyurus maculatus	Spotted-tailed Quoll	Yes	-
Haliaeetus leucogaster (Foraging)	White-bellied Sea-Eagle	Yes	-
Hieraaetus morphnoides (Foraging)	Little Eagle	Yes	-
Lathamus discolor (Foraging)	Swift Parrot	Yes	-
Macropus dorsalis	Black-striped Wallaby	Yes	-
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	Yes	-
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Yes	-
Miniopterus orianae oceanensis (Foraging)	Large Bent-winged Bat	Yes	-
Neophema pulchella	Turquoise Parrot	Yes	-
Nyctophilus corbeni	Corben's Long-eared Bat	Yes	-
Petroica boodang	Scarlet Robin	Yes	-
Petroica phoenicea	Flame Robin	Yes	-
Phascolarctos cinereus (Foraging)	Koala	Yes	-
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	Yes	-
Pteropus poliocephalus (Foraging)	Grey-headed Flying-fox	Yes	-
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Yes	-
Stagonopleura guttata	Diamond Firetail	Yes	-
Tyto novaehollandiae (Foraging)	Masked Owl	Yes	-

4.1.9 Species Credit Species

Step 1: Identify threatened species for assessment

A list of predicted species credit species for the Development Site was reviewed in the BAM calculator. Species credits pertain to threatened species that cannot be predicted by the vegetation present.

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Step 2: Assessment of the habitat constraints and vagrant species on the subject land & Step 3: Identify candidate species credit species for further assessment

The potential for identified species credit species to occur on the Development Site was assessed according to species specific habitat requirements, as detailed in **Table 6**.

Where habitat features were not present due to the degraded condition of the site vegetation, species credit species were determined to not be candidate species and no further assessment was required (**Table 6**).

Table 6: Species credit species and justification for inclusion as candidate species.

Scientific name	Common name	Confirmed Candidate Species	Justification
Flora			
Acacia atrox	Myall Creek Wattle	Yes	-
Dicanthium setosum	Bluegrass	Yes	-
Digitaria porrecta	Finger Panic Grass	Yes	-
Euphrasia arguta	Euphrasia arguta	Yes	-
Homopholis belsonii	Belson's Panic	Yes	-
Picris evae	Hawkweed	**No**	**Species is not previously recorded within the Peel Sub-IBRA Region and is therefore considered to be vagrant.**
Thesium australe	Austral Toadflax	Yes	-
Tylophora linearis	Tylophora linearis	Yes	-
Amphibians			
Adelotus brevis - endangered population	Tusked Frog population in the Nandewar and New England Tableland Bioregions	**No**	**Species is not previously recorded within the Peel Sub-IBRA Region and is therefore considered to be vagrant.**
Litoria booroolongensis	Booroolong Frog	**No**	**Habitat degraded – degraded habitat due to a lack of vegetation and aquatic habitat offering refugia.**
Birds			
Burhinus grallarius	Bush Stone-curlew	**No**	**Habitat constraints (breeding) not present**: Fallen/standing dead timber including logs.
Calyptorhynchus lathami (Breeding)	Glossy Black-Cockatoo	**No**	**Habitat constraints (breeding) not present**: Hollow bearing trees; Living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground.

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Scientific name	Common name	Confirmed Candidate Species	Justification
Haliaeetus leucogaster (Breeding)	White-bellied Sea-Eagle	**No**	**Habitat constraints (breeding) not present**: Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands and coastlines.
Lathamus discolor (Breeding)	Swift Parrot	**No**	**Habitat constraints (breeding) not present:** Study Area not within mapped important habitat.
Tyto novaehollandiae (Breeding)	Masked Owl	**No**	**Habitat constraints (breeding) not present:** Hollow bearing trees; Living or dead trees with hollows greater than 20 cm diameter.
Mammals			
Aepyprymnus rufescens	Rufous Bettong	No	Habitat degraded – degraded habitat due to a lack of vegetation with a shrub layer offering refugia.
Cercartetus nanus	Eastern Pygmy-possum	No	Species is not previously recorded within the Peel Sub-IBRA Region and is therefore considered to be vagrant.
Chalinolobus dwyeri	Large-eared Pied Bat	**No**	**Habitat constraints not present:** Cliffs; Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.
Miniopterus orianae oceanensis (Breeding)	Large Bent-winged Bat	**No**	**Habitat constraints (breeding) not present:** Caves; Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC - in cave;" observation type code "E nest-roost;" with numbers of individuals >500.
Petaurus norfolcensis	Squirrel Glider	**No**	Habitat degraded – degraded habitat due to lack of trees and habitat connectivity.

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Scientific name	Common name	Confirmed Candidate Species	Justification
Phascogale tapoatafa	Brush-tailed Phascogale	**No**	Habitat degraded – degraded habitat due to lack of trees and habitat connectivity.
Phascolarctos cinereus (Breeding)	Koala	**No**	**Habitat constraints not present:** Areas identified via survey as important habitat (see comments).
Pteropus poliocephalus (Breeding)	Grey-headed Flying-fox	**No**	**Habitat constraints (breeding) not present:** Breeding camps.
Vespadelus troughtoni	Eastern Cave Bat	**No**	**Habitat constraints not present:** Caves; Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, crevices or boulder piles, or within two kilometres of old mines, tunnels, old buildings or sheds.

4.1.10 Threatened Flora and Fauna Surveys

4.1.10.1 Threatened Flora

The candidate threatened flora species were surveyed in accordance with *Surveying Threatened Plants and their Habitats* (DPIE 2020e). All surveys were conducted using systematic parallel transects. Parallel field traverses were separated by 10 m and occurred within the appropriate survey period (March 2020, January 2021) for relevant threatened plant species.

A total of 58 plant species were identified during the assessment. These were comprised of 26 exotics and 32 natives. A complete list of flora species is presented in **Appendix 2**. No threatened flora or fauna species were identified within the Development Site during field surveys (**Figure 4**).

The majority of the exotic plant species were comprised of annual herbs and grasses associated with the grasslands. Native plant species were comprised mainly of grasses. One tree species (White Box *Eucalyptus albens*) was detected.

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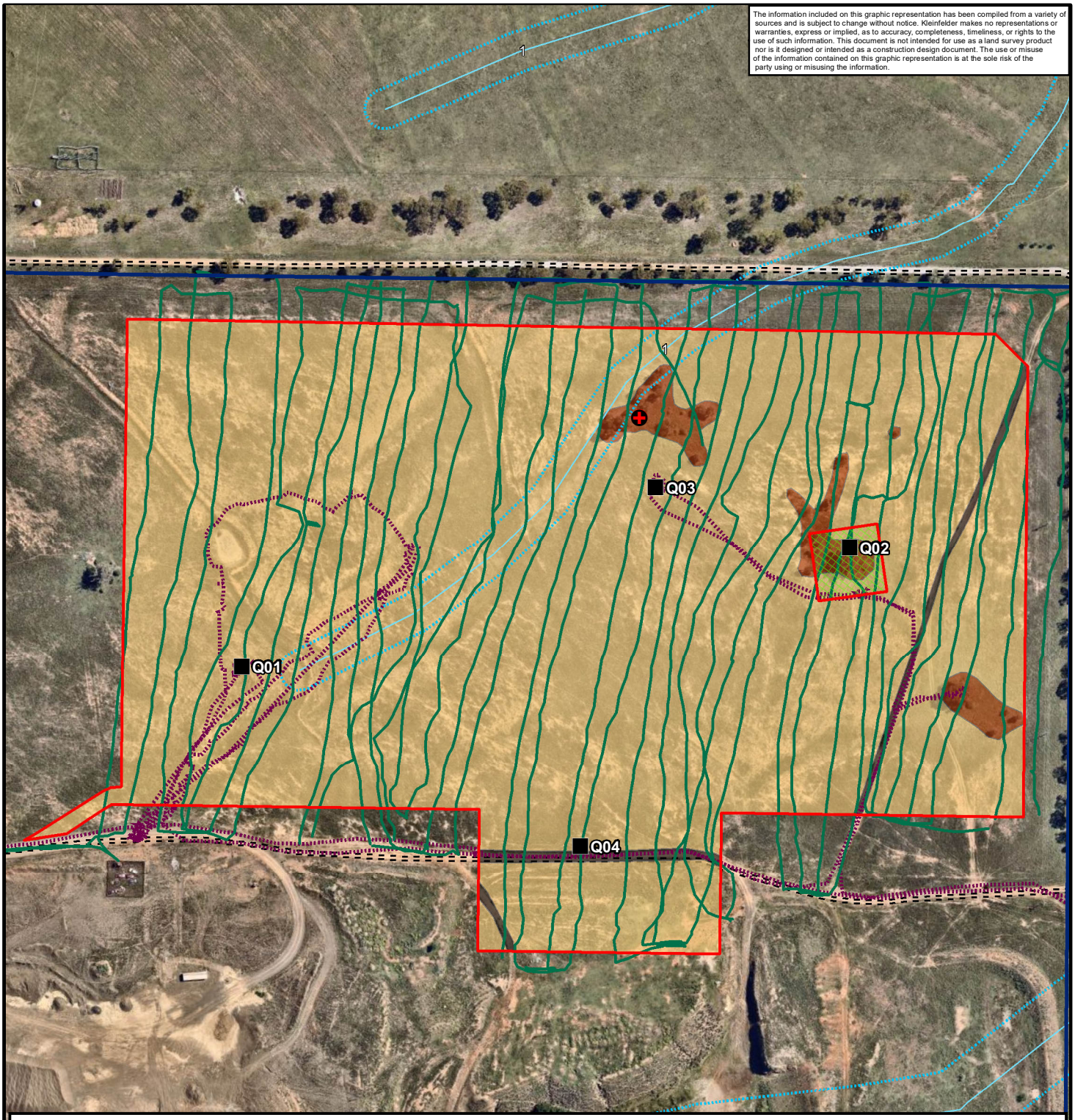
4.1.10.2 Fauna Species

No threatened fauna species were detected during the assessment. Opportunistic fauna observations included sightings of common bird species such as the Australian Magpie and the Noisy Miner. No reptile or amphibian species were detected. Microbat species detected via Anabat included the following:

- Gould's Wattled Bat *Chalinolobus gouldii.*
- Southern Free-tailed Bat *Mormopterus planiceps.*
- Inland Free-tailed Bat *Mormopterus petersii.*
- Eastern Free-tailed Bat *Mormopterus ridei.*
- Inland Broad-nosed Bat *Scotorepens balstoni.*
- Little Forest Bat *Vespadelus vulturnus.*

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Legend

- Development Site Boundary
- Study Area Boundary (Lot 211 DP 1069964)
- Excluded from BDAR (scar tree fenced area)
- Plot Transect
- Anabat
- Meander Survey (04/03/2020)
- Targeted Threatened Flora Search (04/01/2021)
- Watercourse (Labelled with stream order)
- Riparian Buffers
- Track

Plant Community Types and Vegetation Zones

- PCT 511 - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Low Condition Grasslands) - **Zone 1**
- PCT 511 - Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion (Low Condition Woodlands) - **Zone 2**
- Tracks

Metres
0 10 20 40 60 80 100

N

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PROJECT REFERENCE: 20203963
DATE DRAWN: 2021/01/21 16:18 Version 2
DRAWN BY: GJoyce
DATA SOURCE:
NSW DFSI - 2018
NSW OEH - 2019
Nearmap - 2020

Survey Effort

KDC Pty Ltd
Biodiversity Development Assessment Report
South Tamworth Solar Farm

FIGURE:
4

L:\GIS FOLDER\00 CLIENT FILES\130060_KDC_PtyLtd\20203963_TamworthSolarFarm_DueDiligence\Mapping\20203963_BDAR_Fig04_SurveyEffort.mxd

5. AVOID AND MINIMISE IMPACTS ON BIODIVERSITY VALUES

5.1 AVOIDING AND MINIMISING IMPACTS DURING PROJECT PLANNING

5.1.1 Avoid and Minimise Impacts on Native Vegetation and Habitat

Impacts on biodiversity values have been addressed through an iterative design process to avoid areas of higher biodiversity value within the Development Site. The location and design of the solar panel array ensures that very few mature trees will require removal.

5.2 ASSESSMENT OF IMPACTS

5.2.1 Impacts on Native Vegetation and Habitat

5.2.1.1 Vegetation Removal

Removal of native vegetation within the Development Site will be limited to the removal of native groundcover and isolated mature trees and shrubs (i.e. 37 trees and shrubs total, including two hollow-bearing trees) (**Figure 3**). It is estimated via GIS analysis that the following areas of native vegetation will be disturbed/ removed:

- 11.05 ha of low condition grasslands.
- 0.26 ha of low condition woodlands.

5.2.1.2 Impacts to Fauna

Potential indirect impacts of the proposed development on resident fauna populations include the following:

- Noise and lighting during the construction phase may cause minor disturbance to resident fauna within the locality and disrupt their natural behaviour.

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- 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 the constructed dams and downstream aquatic habitat.

Management measures are presented in **Section 5.3** to reduce the potential for these impacts.

5.2.1.3 Impacts to Aquatic Habitat

The proposed development has been designed to avoid directly impacting the mapped waterways within the Study Area. The mapped stream in the Development Site is ephemeral and contains no riparian vegetation indicating that it has been dry throughout the year(s), therefore direct impacts are considered to be negligible. Potential indirect impacts include the following:

- The excavation of soil within the Development Site during the construction phase has the potential to facilitate erosion and sediment movement. Runoff from the Development 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 5.3.**

5.2.1.4 Impacts to Surrounding Vegetation

Although unlikely, the proposed development has the potential for indirect impacts on the vegetation surrounding the Study Area. Potential indirect impacts include:

- Increased weed invasion and potential spread or introduction of pathogens from the site to nearby vegetation.
- Erosion and sedimentation into nearby vegetation.
- Reduced viability of adjoining habitats due to increased noise, dust or light spill during operational phase.

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Provided appropriate mitigation measures and management plans are enforced, it is unlikely to have a significant long-term effect on biodiversity values in the locality.

5.2.2 Prescribed Impacts

The proposed development is not considered to have the potential to impact on any prescribed impacts.

5.2.3 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.

5.3 MITIGATING AND MANAGING IMPACTS ON BIODIVERSITY VALUES

The measures outlined below should be adhered to prior and during vegetation clearing to ensure that impacts are minimised.

Table 7: Summary of direct, prescribed and indirect impacts of the proposed development

Impact	Action and Outcome	Responsibility	Timing
Direct impact / prescribed impact			
Clearing of native vegetation	• A suitably trained Ecologist should be present onsite to supervise vegetation clearing activities and manage displaced fauna species. • Areas of vegetation outside the development footprint are to be clearly demarcated to prevent accidental clearing during the construction phase. • Vegetation should be cleared in a way that will allow fauna species living in or near the clearing site enough time to move out of the area without additional human intervention. • No clearing should occur during the early evening or at night. • The direction of clearing should also ensure that fauna species are directed away from threats such as roads.	Construction site manager	Prior to and during vegetation clearing

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Impact	Action and Outcome	Responsibility	Timing
Management of Displaced Fauna	• All handling of fauna species should be conducted by a suitably trained Ecologist. • Displaced fauna species are to be relocated to adjacent bushland. • Nocturnal fauna species, such as microbats, are to be 'soft released' using bat boxes placed in adjacent habitat. • Nocturnal fauna species, such as gliders and possums, are to be secured in suitable enclosures and kept in a quiet, dark and cool environment until they can be released into suitable habitat after dark. • If any injured fauna species are found during the construction period, construction must stop immediately so that the injured animal is to be taken to a vet or wildlife carer.	Construction site manager	Prior to and during vegetation clearing
Vehicle collision with fauna	• Speed limits within the Development Site should be limited to 40 km/hr. • Driving during dawn and dusk to be avoided where practicable.	Construction site manager	During vegetation clearing and construction
Indirect Impact			
Transfer of weeds and pathogens to and from site	• All vehicles and machinery should be inspected prior to entering the site to ensure that they are clean and free of weeds or soil. • All soil and seed material from site to be disposed of at landfill (no dumping in adjacent areas).	Construction site manager	During vegetation clearing and construction
Increase in dust, light and noise during clearing works	• Impacts from operational activities, such as disturbance to an animal's normal behaviour patterns due to noise, vibration, lighting or dust may cause surrounding areas of previously suitable habitat to become sub-optimal and may cause fauna species to vacate areas of previously suitable habitat. • Construction works to be limited to daylight hours. • Reduce machinery noise where possible during clearing. • Dust suppression measures such as water to be utilised as necessary.	Construction site manager	During vegetation clearing and construction
Erosion and sedimentation	• 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.	Construction site manager	Prior to commencement of works.
Waste	• All chemicals must be kept in clearly marked bunded areas. • Regularly inspect vehicles and mechanical plant for leakage of fuel or oil.	Construction site manager	Prior to and during tree clearing.

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Impact	Action and Outcome	Responsibility	Timing
	• No re-fuelling of vehicles, washing of vehicles or maintenance of vehicles and plant to be undertaken within 20 m of natural drainage lines. • Waste management procedures to be identified prior to commencement of works. • Spill Response Procedures to be in place and spill kits to be present during clearing works. • All general waste to be removed from site.		

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6. IMPACT SUMMARY

6.1 SERIOUS AND IRREVERSIBLE IMPACTS

No Serious and Irreversible Impacts (SAIIs) were found to occur on the Development Site.

6.2 IDENTIFICATION OF IMPACTS REQUIRING OFFSETS

This section provides an assessment of the impacts requiring offsetting in accordance with Section 10.1 of the BAM (DPIE, 2020a).

6.2.1 Impacts on Native Vegetation

A summary of the impacts on native vegetation and the required ecosystem credit is provided in **Table 8**. The vegetation integrity score threshold is >17, therefore impacts to vegetation Zone 1 are not required to be offset. The like-for-like Credit Report is provided in **Appendix 4**.

Table 8: Summary of ecosystem credit requirements

Vegetation Zone	Vegetation Zone Name	Area (ha)	Current Vegetation Integrity Score	Future Vegetation Integrity Score	Credits Required
1	PCT 511_Low (Grasslands)	11.05	9.2	0	0
2	PCT 511_Low (Woodlands)	0.26	32.4	0	3
Total Credit Requirement					**3**

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7. ASSESSMENT OF OTHER BIODIVERSITY LEGISLATION

7.1 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

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 Development 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.

7.2 BIOSECURITY ACT 2015

Minor infestations of weeds were identified, including the following priority and WoNS species:

- African Love Grass *Eragrostis curvula.*
- African Box Thorn *Lycium ferocissimum.*
- Bathurst Burr *Xanthium spinosum.*

Mitigation measures to prevent the spread of weeds are presented previously in **Section 5.3.**

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APPENDIX 1. FLORA SPECIES LIST

Table 9: Flora species list for the Development Site

Growth Form	Plant Species	Plot 1		Plot 2		Plot 3		Plot 4	
		Cov.	Ab.	Cov.	Ab.	Cov.	Ab.	Cov.	Ab.
Exotic Herb	*Amaranthus sp.*						0.1	1	
Native Grass	*Aristida ramosa*			1	100	20	10000	5	500
Native Grass	*Aristida vagans*					0.1	20		
Native Grass	*Austrostipa sp.*	0.25	100						
Native Grass	*Austrostipa verticillata*			10	500				
Native Forb	*Boerhavia dominii*	2	200			2	500	2	50
Native Grass	*Bothriochloa macra*								
Exotic Grass	*Bromus diandrus*	20	10000	20	10000	20	10000	20	10000
Native Forb	*Calotis lappulacea*					0.1	10		
Native Sedge	*Carex inversa*			0.1	2				
Native Fern	*Cheilanthes sieberi*	0.1	1			0.1	10	0.1	2
Exotic Herb	*Chenopodium murale*								
Native Grass	*Chloris truncata*	0.25	50			2	50	1	50
Exotic Grass	*Cynodon incompletus*			2	1000				
Native Grass	*Dicanthium sericeum*		10000	5	10000	20	10000	5	1000
Native Grass	*Digitaria sp.*	1	50			1	100	0.1	1
Exotic Herb	*Dysphania pumilio*	0.5	50	0.1	2	0.5	50	1	50
Native Chenopod	*Einadia trygonos*			30	10000			2	200
Native Grass	*Enneapogon gracilis*	20	1000	5	1000			20	10000
Exotic Grass	*Eragostis curvula*			2	100	0.1	20		
Exotic Grass	*Eragrostis cilianensis*	5	1000	0.1	10			0.5	20
Native Grass	*Eragrostis brownii*								
Native Tree	*Eucalyptus albens*			20	9				
Exotic Herb	*Euphorbia maculata*	0.25	50			0.5	50		
Native Forb	*Geranium solanderi*								
Exotic Herb	*Glossocardia bidens*								

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Growth Form	Plant Species	Plot 1		Plot 2		Plot 3		Plot 4	
		Cov.	Ab.	Cov.	Ab.	Cov.	Ab.	Cov.	Ab.
Native Forb	*Glycine tabacina*			0.1	10				
Exotic Herb	*Gomphrena celisoides*								
Exotic Herb	*Heliotropium amplexicaule*	0.25	1						
Exotic Herb	*Hypochaeris radicata*					0.1	1		
Exotic Herb	*Lepidium africanum*			0.1	2				
Exotic Shrub	*Lycium ferocissimum*			1	2				
Native Chenopod	*Maireana microphylla*								
Exotic Herb	*Malva parviflora*			0.1	10				
Native Grass	*Microlaena stipoides*			0.1	50				
Native Forb	*Oxalis perrenans*								
Exotic Grass	*Panicum capillare*					0.1	1	2	50
Native Grass	*Panicum simile*							0.1	1
Exotic Herb	*Pelargonium sp.*			0.1	10				
Native Grass	*Poa sp.*			0.1	10				
Native Forb	*Polymeria longifolia*					0.1	5		
Native Forb	*Portulaca oleracea*	0.5	100	1	50	2	500	2	500
Exotic Herb	*Rumex brownii*	0.1	1						
Native Chenopod	*Salsola australis*					0.1	1	0.1	1
Exotic Tree	*Schinus molle*								
Exotic Herb	*Schkuria pinnata*							0.1	5
Native Chenopod	*Sclerolaena muricata*								
Native Forb	*Sida corrugata*					0.1	20		
Exotic Herb	*Sida rhombifolia*	5	100			1	100	5	1000
Exotic Grass	*Sporobolus sp.*	0.5	500						
Exotic Grass	*Tragus australis*							0.1	10
Native Forb	*Tribulus terrestris*	0.5	50	10	500	2	100	2	500
Exotic Herb	*Trifolium repens*	0.1	10						
Exotic Herb	*Trifolium sp.*								
Exotic Grass	*Urochloa panacoides*	0.1	5	5	50			2	100
Native Forb	*Vittadinia sp.*	0.1	20			1	200	0.5	20
Native Forb	*Walenbergia communis*	0.5	100	1	50	1	100	1	500

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Growth Form	Plant Species	Plot 1		Plot 2		Plot 3		Plot 4	
		Cov.	Ab.	Cov.	Ab.	Cov.	Ab.	Cov.	Ab.
Exotic Herb	*Xanthium spinosum*			0.1	1				

C (%) = Percent Foliage Cover; Ab = Abundance rating

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APPENDIX 2. THREATENED SPECIES DATABASE SEARCH

A list of threatened species, populations and ecological communities that have been reported or modelled to occur within a 5 km radius of the Study Area was obtained from the following databases:

- NSW Department of Planning, Industry and Environment (DPIE) BioNet database: (http://www.bionet.nsw.gov.au/); and
- Department of Agriculture, Water and the Environment (DWAE) Protected Matters search tool: (www.environment.gov.au/erin/ert/epbc/index.html).

Based on information available concerning habitat requirements of threatened species, populations and ecological communities; an assessment was made as to the likelihood of any of the reported matters occurring within the Study Area or using the habitat as an essential part of their foraging range. Marine species and pelagic bird species have been excluded from the assessment due to the obvious lack of suitable habitat within the Study Area, however, indirect impacts on these species have been considered.

The table below summarises the likelihood of threatened species and EPBC Act listed migratory species occurring within the Study Area based on the habitat requirements of each species. A brief definition of the likelihood of occurrence criteria is provided below:

- Known – species identified within the site during surveys.
- High – species known from the area (DPIE BioNet Atlas records), suitable habitat (such as roosting and foraging habitat) present within the site.
- Moderate – species may be known from the area and/or potential habitat is present within the site.
- Low – species not known from the area and/or marginal habitat is present within the site.
- Nil – habitat requirements not met for this species within the site.
-

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Table 10: An assessment of the likelihood of threatened species, populations and ecological communities occurring within the Development Site

No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
Flora								
1.	*Cadellia pentastylis* Ooline	V	V	-	PMST	Forms a closed or open canopy mixing with eucalypt and cypress pine species.There appears to be a strong correlation between the presence of Ooline and low- to medium-nutrient soils of sandy clay or clayey consistencies, with a typical soil profile having a sandy loam surface layer, grading from a light clay to a medium clay with depth. **A readily identifiable species that is detectible at all times of year. Was not detected within the Development Site during the assessment. This site does not contain suitable habitat for this species.**	Nil	Nil
2.	*Callistemon pungens* -	-	V	-	PMST	In NSW the species occurs from near Inverell to the eastern escarpment in New England National Park. It also occurs in the northern tablelands of south-eastern Queensland, mainly in the Stanthorpe area. Habitats range from riparian areas dominated by *Casuarina cunninghamiana subsp. cunninghamiana* to woodland and rocky shrubland. It is often found in rocky watercourses, usually with sandy granite (occasionally basalt) creek beds. **A readily identifiable species that is detectible at all times of year. Was not detected within the Development Site during the assessment. This site does not contain suitable habitat for this species.**	Nil	Nil

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
3.	*Dichanthium setosum* 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 Development Site during the assessment; however, potential habitat is present.**	Moderate	Low
4.	*Euphrasia arguta*	CE	CE	-	PMST	Historic records of the species noted the following habitats: 'in the open forest country around Bathurst in sub humid places', 'on the grassy country near Bathurst', and 'in meadows near rivers'. Plants from the Nundle area have been reported from eucalypt forest with a mixed grass and shrub understorey; here, plants were most dense in an open disturbed area and along the roadside, indicating the species had regenerated following disturbance. **Was not detected within the Development Site during the assessment. This site does not contain suitable habitat for this species.**	Nil	Nil
5.	*Prasophyllum 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. **This species is not known in the Glenn Innes-Guyra Basalts Sub-region. This species was not detected within the Development Site during the assessment.**	Low	Low

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
6.	*Syzygium paniculatum* Magenta Lilypily	E	V	1	Bionet	On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities. **The Development Site is comprised of agricultural lands that contain few native trees. The habitat is considered unsuitable for this species.**	Nil	Nil
7.	*Thesium australe* 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 (*Themeda australis*). This species is a root parasite which takes water and some nutrient from other plants, especially Kangaroo Grass. **The majority of the Development Site has been intensely grazed by livestock. 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.**	Low	Low
8.	*Tylophora linearis*	V	E	-	PMST	Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of *Eucalyptus fibrosa, Eucalyptus sideroxylon, Eucalyptus albens, Callitris endlicheri, Callitris glaucophylla* and *Allocasuarina luehmannii.* **The majority of the Development Site has been intensely grazed by livestock. 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.**	Low	Low
Amphibians								

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
1.	*Litoria booroolongensis* Booroolong Frog, Yellow-spotted Bell Frog	E	E	-	PMST	Live along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. Adults occur on or near cobble banks and other rock structures within stream margins. Shelter under rocks or amongst vegetation near the ground on the stream edge. **No suitable aquatic habitat present within the Development Site.**	Nil	Nil
Birds								
1.	*Anthochaera phrygia* Regent Honeyeater	CE	CE	-	PMST	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 Development 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.	*Botaurus poiciloptilus* Australasian Bittern	E	E	-	PMST	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha spp*.) and spikerushes (*Eleocharis spp*.). **No suitable aquatic habitat is present within the Development Site.**	Nil	Nil
3.	*Calidris ferruginea* 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 Development Site.**	Nil	Nil

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
4.	*Erythrotriorchis radiatus* 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. **No suitable habitat is present within the Development Site.**	Low	Low
5.	*Falco subniger* Black Falcon	V	-	2	Bionet PMST	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring. **The Development 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.	*Glossopsitta pusilla* Little Lorikeet	V	-	1	Bionet	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species. **The Development 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

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
7.	*Grantiella picta* Painted Honeyeater	V	V		PMST	Inhabits Boree/ Weeping Myall (*Acacia pendula*), Brigalow (*A. harpophylla*) 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 Amyema. **The Development 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
8.	*Lathamus discolor* 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 *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Forest Red Gum *E. tereticornis*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens.* **The Development 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

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
9.	*Lophoictinia isura* Square-tailed Kite	V	-	1	Bionet PMST	Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses. In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland. **The Development 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
10.	*Rostratula australis* Australian Painted Snipe	E	E		PMST	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 Development Site.**	Nil	Nil
Mammals								
1.	*Chalinolobus dwyeri* Large-eared Pied Bat	V	V		PMST	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. **No cave habitat is present within the Development Site.**	Nil	Nil
2.	*Dasyurus maculatus (SE mainland population)* Spot-tailed Quoll	V	E	4	Bionet 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 Development 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

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
3.	*Nyctophilus corbeni* Corben's Long-eared Bat	V	v		PMST	Inhabits a variety of vegetation types, including Mallee, Bulloke *Allocasuarina leuhmanni* 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 Development 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
4.	*Petauroides volans* Greater Glider	-	v		PMST	Distribution levels are higher in regions of montane forest containing Manna Gum *(E. viminalis)* and mountain gum *(E. dalrympleana, E. obliqua).* Furthermore, the presence of *E. cypellocarpa* appears to improve the quality of habitat for the greater glider in forests dominated by *E. obliqua.* 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. **The Development 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
5.	*Petrogale penicillata* 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 Development Site.**	Low	Low

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
6.	*Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)* Koala	V	V	1	Bionet PMST	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 (White Box *E. albens*) were identified within the Development 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
7.	*Pteropus poliocephalus* Grey-headed Flying-fox	V	V	12	Bionet PMST	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. **Potential foraging habitat occurs within canopy gums; however, no camps were detected. The habitat is not considered to be important to this species.**	Low	Low
Reptiles								
1.	*Aprasia parapulchella* Pink-tailed Worm Lizard	V	V	-	PMST	Inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks. **The Development 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

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No.	Species	Legal Status*		No. of Records	Source#	Habitat Preferences	Likelihood of occurrence	Potential Impact
		BC Act	EPBC Act					
2.	*Uvidicolus sphyrurus* 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 Development 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
Migratory Species								
1.	*Apus pacificus* 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.	*Hirundapus caudacutus* White-throated Needletail	-	M		PMST	Forages in high open spaces over varied habitat types. **Potential aerial foraging habitat above Study Area.**	Moderate	Low
3.	*Motacilla flava* Yellow Wagtail	-	M		PMST	Typically inhabits inundated fields, saltmarsh and wetlands and occasionally coastal areas. **No suitable habitat within the Study Area.**	Nil	Low
4.	*Myiagra cyanoleuca* 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
5.	*Rhipidura rufifrons* 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

* Legal Status: V = Vulnerable, E = Endangered, CE = Critically Endangered under TSC Act and EPBC Act; M = Migratory under EPBC Act. # Source: BioNet Atlas = Atlas of NSW Wildlife (NSW DPIE), PMST = Protected Matter Search Tool (Commonwealth DAWE).

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APPENDIX 3. PREDICTED AND CANDIDATE SPECIES REPORTS

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BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00021881/BAAS18041/20/00021882	Tamworth Solar Farm	21/12/2020
Assessor Name	Report Created	BAM Data version *
Gilbert Whyte	25/01/2021	36
Assessor Number	Assessment Type	BAM Case Status
BAAS18041	Part 4 Developments (General)	Open
Assessment Revision	BOS entry trigger	Date Finalised
0	BOS Threshold: Area clearing threshold	To be finalised

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Black-striped Wallaby	Macropus dorsalis	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Corben's Long-eared Bat	Nyctophilus corbeni	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Diamond Firetail	Stagonopleura guttata	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Dusky Woodswallow	Artamus cyanopterus cyanopterus	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Flame Robin	Petroica phoenicea	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion

Grey-crowned Babbler (eastern subspecies)	Pomatostomus temporalis temporalis	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Grey-headed Flying-fox	Pteropus poliocephalus	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Hooded Robin (south-eastern form)	Melanodryas cucullata cucullata	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Koala	Phascolarctos cinereus	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Large Bent-winged Bat	Miniopterus orianae oceanensis	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Little Eagle	Hieraaetus morphnoides	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Little Pied Bat	Chalinolobus picatus	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Masked Owl	Tyto novaehollandiae	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Scarlet Robin	Petroica boodang	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Speckled Warbler	Chthonicola sagittata	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Spotted Harrier	Circus assimilis	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Spotted-tailed Quoll	Dasyurus maculatus	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Swift Parrot	Lathamus discolor	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion

Turquoise Parrot	Neophema pulchella	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Varied Sittella	Daphoenositta chrysoptera	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
White-bellied Sea-Eagle	Haliaeetus leucogaster	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Common Name	Scientific Name	Plant Community Type(s)
Glossy Black-Cockatoo	Calyptorhynchus lathami	511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Refer to BAR for detailed justification

Common Name	Scientific Name	Justification in the BAM-C
Glossy Black-Cockatoo	Calyptorhynchus lathami	Habitat constraints

BAM Candidate Species Report

Proposal Details

Assessment Id 00021881/BAAS18041/20/00021882	Proposal Name Tamworth Solar Farm	BAM data last updated * 21/12/2020
Assessor Name Gilbert Whyte	Report Created 25/01/2021	BAM Data version * 36
Assessor Number BAAS18041	Assessment Type Part 4 Developments (General)	BAM Case Status Open
Assessment Revision 0	Date Finalised To be finalised	BOS entry trigger BOS Threshold: Area clearing threshold

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

List of Species Requiring Survey

Name	Presence	Survey Months
Dichanthium setosum Bluegrass	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Digitaria porrecta Finger Panic Grass	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Euphrasia arguta Euphrasia arguta	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Homopholis belsonii Belson's Panic	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Lathamus discolor Swift Parrot	No (surveyed) *Survey months are outside of the months specified in Bionet.	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☑ Survey month outside the specified months?
Phascolarctos cinereus Koala	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Thesium australe Austral Toadflax	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Tylophora linearis Tylophora linearis	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
Booroolong Frog	Litoria booroolongensis	Habitat degraded
Brush-tailed Phascogale	Phascogale tapoatafa	Habitat degraded Species is vagrant

Bush Stone-curlew	Burhinus grallarius	Habitat degraded
Eastern Cave Bat	Vespadelus troughtoni	Habitat constraints
Eastern Pygmy-possum	Cercartetus nanus	Species is vagrant
Glossy Black-Cockatoo	Calyptorhynchus lathami	Habitat constraints
Grey-headed Flying-fox	Pteropus poliocephalus	Habitat constraints
Hawkweed	Picris evae	Species is vagrant
Large Bent-winged Bat	Miniopterus orianae oceanensis	Habitat constraints
Large-eared Pied Bat	Chalinolobus dwyeri	Habitat constraints
Little Eagle	Hieraaetus morphnoides	Habitat constraints
Masked Owl	Tyto novaehollandiae	Habitat constraints
Myall Creek Wattle	Acacia atrox	Habitat degraded
Rufous Bettong	Aepyprymnus rufescens	Habitat degraded Species is vagrant
Squirrel Glider	Petaurus norfolcensis	Habitat degraded
Tusked Frog population in the Nandewar and New England Tableland Bioregions	Adelotus brevis - endangered population	Species is vagrant
White-bellied Sea-Eagle	Haliaeetus leucogaster	Habitat constraints

APPENDIX 4. LIKE-FOR-LIKE BIODIVERSITY CREDIT REPORT

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BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00021881/BAAS18041/20/00021882

Proposal Name
Tamworth Solar Farm

BAM data last updated *
21/12/2020

Assessor Name
Gilbert Whyte

Assessor Number
BAAS18041

BAM Data version *
36

Proponent Names

Report Created
25/01/2021

BAM Case Status
Open

Assessment Revision
0

Assessment Type
Part 4 Developments (General)

Date Finalised
To be finalised

BOS entry trigger
BOS Threshold: Area clearing threshold

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Nil

Additional Information for Approval

BAM Biodiversity Credit Report (Like for like)

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
Calyptorhynchus lathami / Glossy Black-Cockatoo

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion	Not a TEC	11.3	0	3	3

511-Queensland Bluegrass - Redleg Grass - Rats Tail Grass - spear grass - panic grass derived grassland of the Nandewar Bioregion and Brigalow Belt South Bioregion	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region

	Western Slopes Grassy Woodlands This includes PCT's: 201, 202, 266, 267, 268, 272, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 301, 316, 326, 337, 347, 383, 395, 421, 426, 433, 434, 436, 437, 441, 444, 451, 461, 464, 483, 509, 511, 516, 544, 589, 590, 593, 599, 711, 847, 851, 955, 1303, 1304, 1315, 1329, 1383, 1401, 1609, 1687, 1693, 1695, 1767	Western Slopes Grassy Woodlands <50%	511_Woodland	No	3	Peel, Eastern Nandewars, Hunter, Inverell Basalts, Kaputar, Liverpool Plains, Liverpool Range, Northern Basalts, Tomalla and Walcha Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Western Slopes Grassy Woodlands This includes PCT's: 201, 202, 266, 267, 268, 272, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 286, 301, 316, 326, 337, 347, 383, 395, 421, 426, 433, 434, 436, 437, 441, 444, 451, 461, 464, 483, 509, 511, 516, 544, 589, 590, 593, 599, 711, 847, 851, 955, 1303, 1304, 1315, 1329, 1383, 1401, 1609, 1687, 1693, 1695, 1767	Western Slopes Grassy Woodlands <50%	511_Grassland	No	0	Peel, Eastern Nandewars, Hunter, Inverell Basalts, Kaputar, Liverpool Plains, Liverpool Range, Northern Basalts, Tomalla and Walcha Plateau. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

No Species Credit Data

Credit Retirement Options

Like-for-like credit retirement options

APPENDIX 5. STAFF CONTRIBUTIONS

The following staff were involved in the compilation of this report.

Name	Qualification	Title/Experience	Contribution
Gilbert Whyte	BSc (PhD) Accredited BAM Assessor	Senior Ecologist	Fieldwork and Reporting
David Martin	MSc	Ecologist	Report Review
Gayle Joyce	BSc Forestry (Hons)	GIS Specialist	GIS data management and Figure preparation
Chelayne Whyte	BSc Geography	Ecologist	Field Surveys

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APPENDIX 6. LICENSING

Kleinfelder employees involved in the current study are licensed or approved under the *Biodiversity Conservation Act 2016* (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.

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21/07/2020

Project Number: 200335

STORMWATER MANAGEMENT REPORT

at

SOUTH TAMWORTH SOLAR FARM | COUNTRY ROAD WESTDALE NSW

for

PROVIDENCE ASSET GROUP c/- KDC Pty Ltd

Project No. 200335

Revision: D - Reissued for DA

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1. Introduction

DRB Consulting Engineers (DRB) were engaged by KDC Pty Ltd, on behalf of Providence Asset Group to undertake a Stormwater Management Plan for the proposed South Tamworth Solar Farm, located at Country Road, Westdale.

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. Additional information and/or reports may need to be developed prior to lodgement of the Construction Certificate submission.

This report should be read in conjunction with the Concept Stormwater Management plans 200335/CIV01-02.

2. Site Description & Proposed Development

The site is located at Country Road, Westdale. The site is located on the eastern side of Country Road and is identified as Lot 211 DP 1069964.

The proposed South Tamworth Solar Farm will be located in the North-East 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 13.43 Ha in area. The IA had a good grass coverage and sloped from the southwest to the northeast at slopes of approximately 3.0 – 3.5%.

The IA had an existing watercourse located in the northern section of the site. During rainfall events, surface runoff from the IA would sheet flow across the site and discharge over the north-eastern corner boundary to this existing watercourse. A small section of the southern side of the site naturally drained towards the southeaster corner, where it discharges into an existing watercourse.

Figure 1 below shows the existing site and investigation area.



Figure 1 – Existing Site Boundaries

It is proposed that the South Tamworth Solar be constructed within the Investigation Area. The proposed Solar Farm layout can be seen in Figure 2 below.

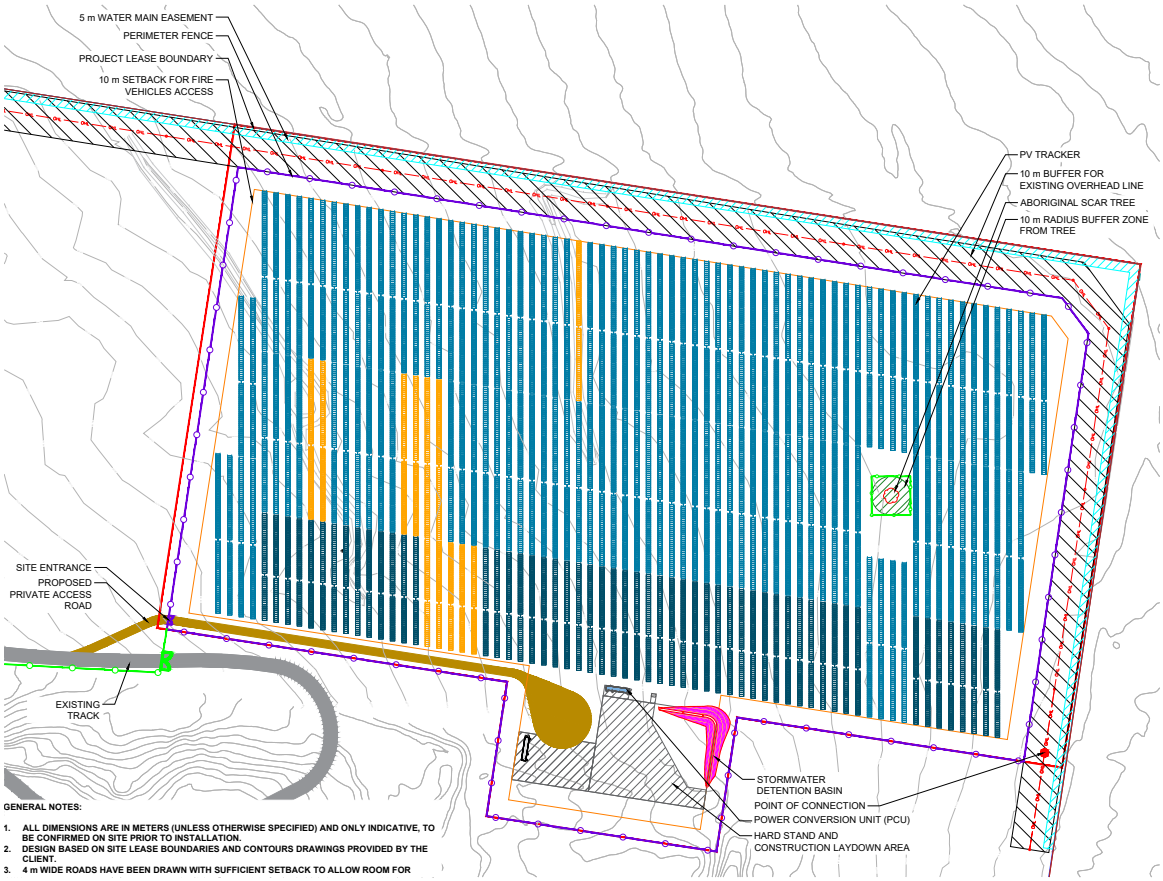


Figure 2 – Proposed Solar Farm

3. Pre-Lodgement Meeting and Council Correspondence

A Pre-Lodgement Meeting was undertaken with Tamworth Regional Council, and further discussions were undertaken over the phone with Tamworth Regional Council's Development Engineers. The following items relevant to the civil aspects of this project were discussed:

- *The proposed development must detain stormwater runoff using a Detention Basin, and the Basin outlet must be designed to bring the discharge rate Post-Development back to Pre-Development flow rates.*

4. Water Quantity Analysis

4.1. Overview

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

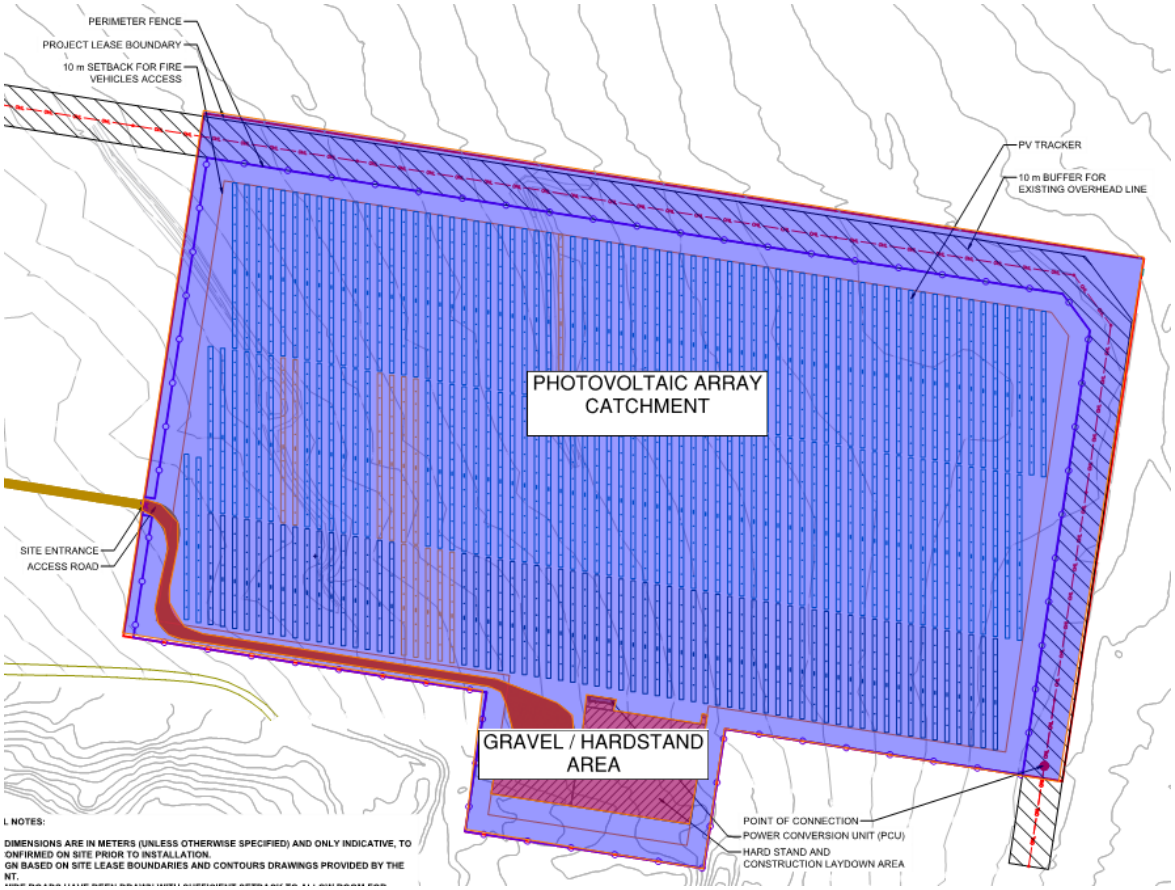


Figure 3 – Proposed Catchment Boundaries

4.2. Photovoltaic Array

The Photovoltaic Array will consist of 180 x Ground Mounted Single Axis Trackers. The array structure will be steel pile supported and will have approximately 600mm 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:

Parameter	
Sub-Catchment Area	90,034.7 m^2
Percentage Impervious	0 %
Flowpath Length	455 m
Flowpath Slope	3.34 %
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.

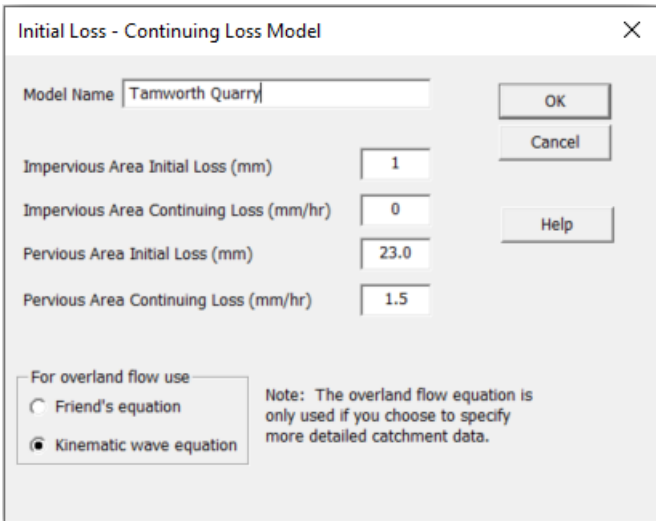


Figure 4 – Hydrological Model Parameters

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	6 hours
10 minutes	45 minutes	9 hours
15 minutes	1 hour	12 hours
20 minutes	2 hours	18 hours
25 minutes	4.5 hours	24 hours

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

Storm Event (Exceedance Probability / Annual Exceedance Probability)	***Peak Flow***
1EY	0.176 m^3/s
10% AEP	0.743 m^3/s
1% AEP	1.730 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. With the exception of the removal of some of the existing earth berms to reinstate the natural flow direction.

(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:

Parameter	
Sub-Catchment Area	90,034.7 m^2
Percentage Impervious	36.30 %
Flowpath Length	455 m
Flowpath Slope	3.34 %
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 1.363. 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.

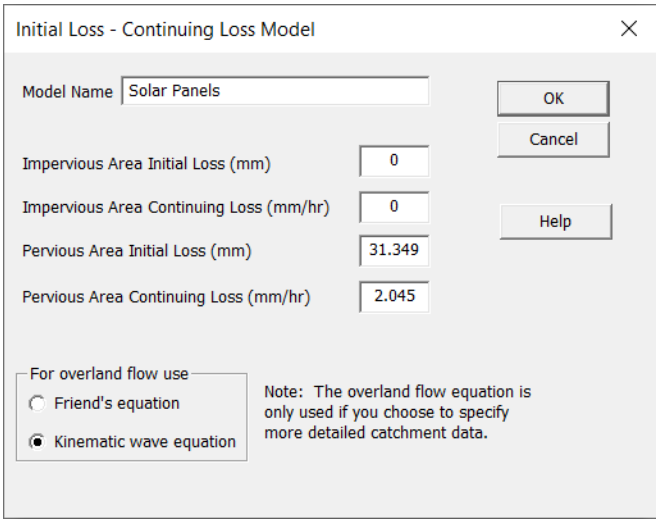


Figure 5 – Hydrological Model Parameters

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

Storm Event (Exceedance Probability / Annual Exceedance Probability)	***Pre-Development Peak Flow***	***Post-Development Peak Flow***	***Difference***
1EY	0.176 m^3/s	0.196 m^3/s	+ 0.020 m^3/s
10% AEP	0.743 m^3/s	0.759 m^3/s	+ 0.016 m^3/s
1% AEP	1.730 m^3/s	1.680 m^3/s	- 0.050 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.

Whilst the modelling strategy outlined in Section 4.2.2 above is an approximation only, in order to be conservative, the increase in peak flow for the 1EY and 10% storm events have been offset in the peak flows allowed to be released from the detention basin designed for the Gravel / Hardstand areas.

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 a road-side swale and a swale on the low side of the hardstand area capturing and conveying these flows to a new above ground onsite stormwater detention basin.

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***	
Road	Sub-Catchment Area	2,967.4 m^2
	Percentage Impervious	0 %
	Flowpath Length	308 m
	Flowpath Slope	3.0 %
	Retardance Coefficient 'n'	0.075
Hardstand Area	Sub-Catchment Area	5,504.5 m^2
	Percentage Impervious	0 %
	Flowpath Length	106 m
	Flowpath Slope	6.6 %
	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 determi1`ned 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.

Storm Event (Exceedance Probability / Annual Exceedance Probability)	***Combined Peak Flow***
1EY	0.023 m^3/s
10% AEP	0.099 m^3/s
1% AEP	0.235 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) The overland flow path for the road consisted of 4m across the road and 304m within a grass lined swale. The retardance coefficient of 0.075 was maintained for the road catchment.
(iii) The overland flow path for the hardstand area was treated as totally impervious and a retardance coefficient of 0.013 was adopted.

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

Catchment	***Parameter***	
Road	Sub-Catchment Area	2,967.4 m^2
	Percentage Impervious	40.49 %
	Flowpath Length	308 m
	Flowpath Slope	3.0 %
	Retardance Coefficient 'n'	0.075
Hardstand Area	Sub-Catchment Area	5,504.5 m^2
	Percentage Impervious	87.18 %
	Flowpath Length	1.6 m
	Flowpath Slope	6.6 %
	Retardance Coefficient 'n'	0.013

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 7below.

OSD Basin	
Basin Invert	409.55m AHD
Basin – Top of Bank	410.7m AHD
Weir Width	10.0 m
Weir Level	410.65m AHD
Basin Volume	256.362 m^3
Outlet Pipe (@ base)	150mm diam
Outlet Pipe Orifice	40mm 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	0.023 m^3/s	0.108 m^3/s	0.003 m^3/s	- 0.020 m^3/s	410.65m AHD
10% AEP	0.099 m^3/s	0.199 m^3/s	0.069 m^3/s	- 0.030 m^3/s	410.68m AHD
1% AEP	0.235 m^3/s	0.313 m^3/s	0.196 m^3/s	- 0.039 m^3/s	410.70m 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 South Tamworth Solar Farm at Country Road, Westdale 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 grass-lined swales 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, taking in to account the offset required.

Provided the above stormwater drainage philosophy is adopted for the site, the proposed South Tamworth 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



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